DOCUMENT RESUME

ED 200 414		SE 034 457

TITLE Pennsylvania's Energy Curriculum for the Secondary Grades: Social Studies.
INSTITUTION Pennsylvania State Dept. of Education, Harrisburg.
SPONS AGENCY Pennsylvania State Governor's Energy Council, Harrisburg.
PUB DATE 80
NOTE 73p.: For related documents, see SE 034 450-456.

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Community Action: Current Events: *Energy: *Environmental Education: Global Approach: Secondary Education: *Social Studies: *Technological Advancement: Technology: Values Clarification
IDENTIFIERS Alternative Energy Sources

ABSTRACT

The crux of energy-related issues goes beyond technological matters to the political, economical, cultural, geographical, and historical aspects of human society. Accordingly, this manual presents background information and lessons that are designed to help secondary school social studies classes examine several facets of energy problems and solutions. Unit I, Pumping Iron, looks at energy from an historical perspective in an effort to identify some causes and effects. The next unit, Energy Alternatives Today, raises political and economical issues on the local and national levels. Unit III, A Global Perspective, is devoted to worldwide implications, while the final section, The Local Community as a Model, aims at personal and civic action. Numerous maps, charts, and diagrams illustrate the written material. (Author/WB)

ENERGY

PENNSYLVANIA'S ENERGY CURRICULUM FOR THE SECONDARY GRADES

Social Studies

Pennsylvania Department of Education 1980
Funds Provided by Governor's Energy Council

Commonwealth of Pennsylvania
Dick Thornburgh, *Governor*

Department of Education
Robert G. Scanlon, *Secretary*

Office of Basic Education
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SOCIAL STUDIES AND ENERGY

Introduction

Energy and environmental problems offer a fertile field for social studies that should not be neglected. Science has been concerned with these issues, but the real crux of the matter goes beyond the technological to the political, economic, cultural, geographical, and historical aspects of life. Many of these concerns involve local and national policies, but the very nature of the problem forces the study into global dimensions. Resources are located globally. Multinational corporations flow over political boundaries, and political decisions in one nation have ramifications worldwide.

The format of this module looks first at the long sweep of history and energy from prehistoric times onward in an effort to get at causes and effects concerning technology and society. The second unit raises political and economic issues on the local and national levels. The third portion is devoted to global concerns and implications, while the fourth is aimed at personal and civic action that might provide political efficacy.

However, the energy issue is not merely one of knowledge. Political and economic decisions are value-laden. Energy production and use is a primary concern of environmentalists today. To be made aware of our current environmental problems, the student must take into account personal, community, national, and global energy uses and their environmental impacts.

Many energy issues are quite controversial. Nuclear power is a prime example. Some of the readings in this module reflect these controversial issues, and should not be construed to be any sort of *official position.* They should be used to stimulate discussion and motivate students to seek information from many sources.

As the teacher introduces the energy/environment problems to the student, he/she should attempt to engage the student in clarifying values and making decisions based on knowledge, attitudes, and beliefs. The students must be involved in finding solutions to environmental problems related to energy—the alternatives, trade-offs, compromises, and costs.

Finally, the students should be encouraged to commit themselves to some type of constructive action which improves the quality of the environment.

The following value-sorting exercise is provided to assist you in determining the level of understanding and value orientation of your students prior to implementing the energy curriculum. You might wish to modify your approach based on the results of this exercise. It might also be used in a pre-post model to ascertain what changes the curriculum produced.

Value Sorting Exercise
People and Energy Decisions

Divide the class into groups of four or five persons. You will need one set of the energy statements and the sorting sheet that follow for each group. Cut out each of the 24 statements and arrange them numerically in a small envelope marked *Energy*. Give the following instructions to each group:

Open the *Energy* envelope, and read the first statement. Discuss the statement, and decide whether all of the members of your group accept the statement, whether all of you reject it, or whether you disagree among yourselves about it. Place the card on the rectangle on the sorting sheet that matches the decision of your group.

Repeat this process with the next statement, until you have placed all of the statements from the *Energy* envelope in their appropriate recantagles on the sorting sheet, as decisions are reached by your group. When you have completed the statements in the *Energy* envelope, remove the three stacks of cards from the sorting sheet and record your group's decisions on the analysis sheet.

There is no *right* or *wrong* classification for the statements. Many of them are controversial. They have been prepared to stimulate discussions of ideas about environmental problems, and not to tell you how you ought to think.

Discuss the results of the exercise. Are there any statements that all students agreed on? What is the nature of the statements that are most controversial?

PEOPLE AND ENERGY DECISIONS

1 I would be willing to become involved in a car pool to save petroleum despite inconvenience.	2 More of the gas tax money should be used for building or improving bus and train transportation, and less should be spent building highways.
3 Trains should be given more help so that truck traffic could be reduced, thus saving petroleum.	4 If OPEC raises prices too much or an oil boycott is imposed, the U.S. should take over the oil fields by military force.
5 No more nuclear power plants should be built until a safe way is found to dispose of radioactive wastes.	6 The United States should allow prices of energy resources to rise to encourage conservation and to provide incentive to American business to develop more resources.
7 Public utilities should be run by the government.	8 Electrical generating plants and heavy industry should be forced to use coal instead of oil or gas.
9 More money should be invested in solar energy research than in nuclear research.	10 Nuclear energy is vital to our economy, so I would not mind if a nuclear plant were built near my home.
11 The developing nations of the world should not be helped to develop industry unless they do so with careful regard to the environmental impact.	12 An international law should be passed, outlawing use of super-tankers due to the impact of accidents and oil spills.
13 Too much of our energy goes into production of military goods.	14 Oil companies should be prohibited from owning other forms of energy resources.
15 Developing countries should use more wood as fuel.	16 Control of nuclear energy resources should be inthe hands of an international agency.
17 Individuals cannot do much to change the energy situation.	18 Too much of our information on energy is biased by vested interests.
19 We should not rely on foreign nations for energy.	20 Industry should be required to cut back in the amount of energy they use before private citizens are asked to do this.
21 Rationing of gasoline should take place to conserve oil and reduce our balance of payment problem.	22 The average citizen has no impact on energy decisions, since they are all dependent on national and world policies.

SORTING SHEET (Small group)

ACCEPT	
REJECT	
DEBATABLE	

ANALYSIS SHEET (Large Group)

Write Statement Numbers Under Proper Category

Accept	Reject	Debatable

UNIT I

PUMPING IRON

An Historical Perspective

Energy is the ability to do work. This definition must therefore account for the ability to do work from prehistoric times to the present. Most books on energy assume that energy did not become a reality until the 19th century, when inventions brought about an explosion of energy resources and the industrial revolution occurred. The tie between energy and technology is critical, but a view of most basic energy sources during the evolvement of humans can be rewarding.

The term *pump iron* is new on the scene, but its reality in the development of civilization cannot be questioned. However, if the use of mere physical strength or speed were the criteria for advancement, the animals might hold sway over the humans. Indeed, the idea of mental energy, and perhaps psychic energy, holds the key to the progress of humankind.

Recent archeological finds indicate that Homo sapiens emerged well over one million years ago. During this early period, the only major fuel for energy was food, and the only energy was human or animal. Prior to the advent of hunting, coupled with the technological innovation of fire, humans probably generated only 2000 calories a day. As protein increased in the diet, about 100,000 years ago, the calories also increased. Tied in with these early advances was the use of tools which increased the efficiency of human energy.

The invention of fire caused major changes in human existence. Its use for cooking food increased human caloric intake and expanded the variety of foods that were edible. Fire permitted humans to sustain life in colder climates, permitting adaptation to climatic changes. No longer were humans restructed to a singel ecological niche; they could and did scatter over the face of the globe. The flame of the fire also warded off animal predators so that humans could achieve some security. Finally, fire was used to temper first wood, then metals. Is it any wonder that Prometheus was said to have stolen fire from the Gods?

For hundreds of thousands of years, the only fuel for fire was wood or plant materials. During the hunting and gathering period, when the population density was three people per 100 square miles, there was no shortage of wood, since it is a renewable resource. However, several other technological changes, such as the invention of agriculture and the smelting of metals, resulted in specialized labor and urban centers. By the time of Christ the population density in some areas had increased to 250 people per square mile. In the Middle East, where these developments first occurred, wood was becoming scarce.

During this period, which source of energy predominated? Human muscle was still the major source of available energy. Those societies that smelted iron too frequently used this new technology to develop weapons. The conquerors used the energy of the vanquished enemy for labor; thus the quality of life for the few was at the expense of the masses.

It should be noted that other technologies improved available energy sources. The domestication of animals in the Middle East and Eastern Asia, combined with the invention of the wheel, provided a new source of energy that improved trade, transportation, and military conquests. Strangely, although the Inca and Mayan civilizations invented the wheel, there was very limited domestication of animals, and the wheel was used only on toys, never for work.

Thus, through much of the late prehistoric period, right up until the middle of the 17th century, the major sources of power were renewable resources such as wood for fire, grass for animals, wind for sailing, and a few windmills and waterwheels for turning shafts that ground grain and sawed wood. Despite the term *renewable*, because of the increasing demands of a growing population and the progressive expansion of industry, wood became scarce in many areas of the world.

In fact, even today, one third of the world's population depends on firewood for cooking dinner, and these people are facing a great shortage as populations increase. On the Indian subcontinent, the peasants use dried cow dung for cooking, thus robbing the land of needed fertilizer. In the mountains, the rapacious gathering of firewood denudes the land, leading to erosion. These are serious energy problems that cannot be solved by conservation - the poor of these areas need energy sources for survival.

In Europe and America, a substitute resource was available, and as wood became scarce, coal started to be used for heating purpose. Then, in the late 17th century, the invention of the steam engine expanded industrialization and ushered in the age of mass production. The first oil well drilled by Colonel Drake in Titusville, Pennsylvania in 1859, and the invention of the internal combustion engine revolutionized the transportation and chemical industries.

The United States lagged behind Europe in industrilization. In the U.S. in 1850, wood accounted for 90 percent of the fuel consumed with about three quarters of it being used for heating. By 1975 the average consumer had access to 120 times the energy that the hunters and gatherers had, and relied almost completely upon coal, gas, and petroleum, with some nuclear power. According to Franklyn Branley,[1] the daily use of energy, the burning of calories, is 230,000 calories for each person in the world.

So far, the historical survey of the growth of energy indicates a few ways in which the sources and uses of energy affected the lives of people. The rest of this unit will explore more explicity the internations of people with their environment as technology and energy changes the patterns of society.

[1] Branley, Franklyn, Energy for the 21st Century, Thomas Crowell, NY, 1975, Page 9.

Activity I-1

Objectives

1. The students will be able to envision the effects of energy usage upon global historical development.

2. The students will develop skills in making time lines, relating space to time.

What to Do

Divide the students into four groups to develop time lines. Group I will develop a time line from prehistoric times up to the first century A.D. The other three groups will consider the time from the first century to the present, specializing in three different areas: Group II will develop a time line for the Mediterranean area and Europe, Group III for Asia and Africa, and Group IV for the Western Hemisphere. These time lines should indicate major inventions as related to energy as well as major political events. At the conclusion of this exercise, the class will put these time lines together and compare them.

Teacher Notes

Refer to the Introductory Module for a brief review of the historical development of energy. This provides a broad overview for students; however, additional research will need to be conducted in history texts.

Activity I-2

In the previous activity, students pursued a global view of the historical development of energy and its resources. This view provided a broad but superficial insight into the interaction of energy and the changing patterns of human existence.

In this activity students will be asked to focus on the major source of fuel in the world today, petroleum, and be able to describe the effects of this use upon the people of the United States. As in all historical research, the causes and effects become intermingled, but the interaction of inventions and products with people's life patterns is the major point.

Objectives

1. Students will be able to develop a micro-view of the causes and effects of the technological development of a single source of energy (oil) within a single country (USA).

2. Students will be able to interpret charts, graphs, and written data and use the data to apply and describe its effects upon historical change.

What to Do

1. After reading about the discovery of oil in the Introductory Module, and studying Data Sheets A, B, and F, answer the following:

   a. What conditions existed in the United States that led to oil exploration?

   b. What other inventions expanded the use of oil?

   c. What changes did these inventions and discoveries have upon the way people lived?

   Some aspects to be considere, are given on the following chart.

2. Using the following charts and graphs, develop a number of hypotheses concerning the effects of oil on the United States' economy, population, and culture.

   a. From the population data (A) provided, what relationships can be seen between the development of the petroleum and transportation industries?

   b. What other hypotheses might you make concerning population patterns and the development of the petroleum and transportation industries?

   c. What additional data would be necessary to substantiate these hypotheses?

   d. In comparing Data Sheets B and F, what conclusion do you draw concerning the use of petroleum in the U.S.? What data is missing concerning transportation that might expand the reasons for such demand for petroleum in the U.S.?

   e. Using Date Sheet B, can you determine what new power arrangements occurred due to the growth of the petroleum industry? What multinational corporations came into existence? What were the advantages and disadvantages of having these large corporations? What political power do they possess?

   f. When comparing the graphs on Data Sheets C and D, what implications are there for (1) energy conservation (2) foreign policy?

   g. What occurred in 1973 that changed the direction of all that preceeded on Chart D?

   h. Using Data Sheet E and thinking about Data Sheets C and D, what alternative policies of fuel use are suggested?

	Use of Petroleum	Use of Automobiles and Trucks
d Areas Affected		
Industries Developed Support Industries		
Economic Impacts		
ts on Society		
Family		
Population Paterns		
Recreation		
ts on Politics		
ts on Global Inter...		

Data Sheet A
Population Statistics

In 1850, the population of the United States was approximately 23 million. In 1920 it was 106 million, and in 1978 it was 218 million. The population in cities between 1820 and 1900 was:

City	1820	1860	1880	1900
New York	152,000	1,174,800	1,912,000	3,437,000
Philadelphia	63,000	565,500	847,000	1,294,000
Boston	43,300	177,800	363,000	561,000
Baltimore	62,700	212,400	332,000	509,000
Cincinnati	9,610	161,000	255,000	326,000
St. Louis	10,000	[illegible]	[illegible]	[illegible]
Chicago		109,300	[illegible]	[illegible]

*(Why [illegible]

[illegible]

[illegible] is increasing [illegible] consumption [illegible] more oil than any other nation [illegible] 1974, when [illegible] about 14.2 million barrels per da[illegible]

Although oil was discovered [illegible] producing state[illegible] Texas became [illegible] oil producer today. Alaska became a major producer [illegible] 1978

[illegible] France, West Germany and [illegible]

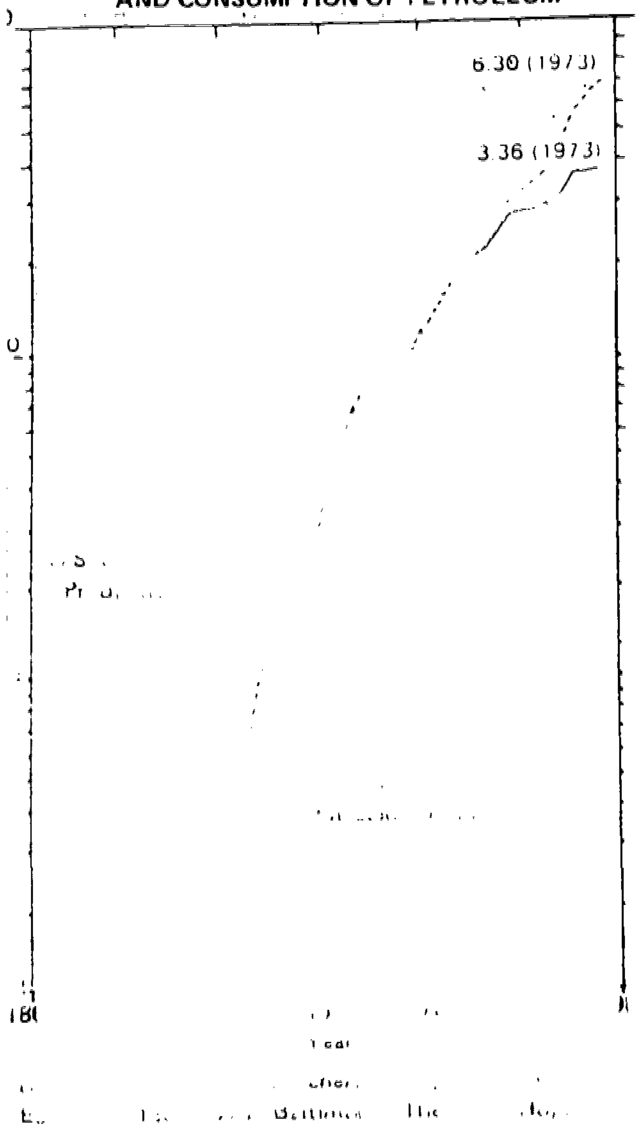
[illegible]

[illegible]
Fuel oil
Jet fuel
Kerosine
Cosmetic[illegible]
Drugs
Anesthe[illegible]

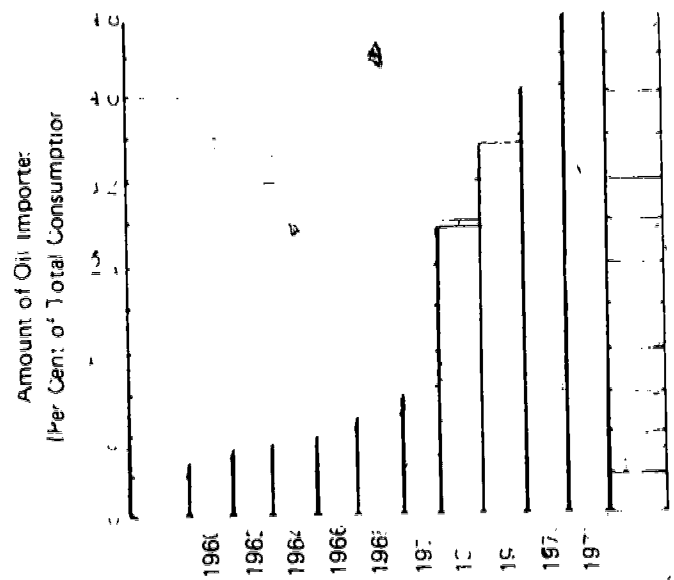
Fertili[illegible]
Detergents
[illegible]
paint [illegible]

Data Sheet C

GRAPH 1
U.S. PRODUCTION
AND CONSUMPTION OF PETROLEUM

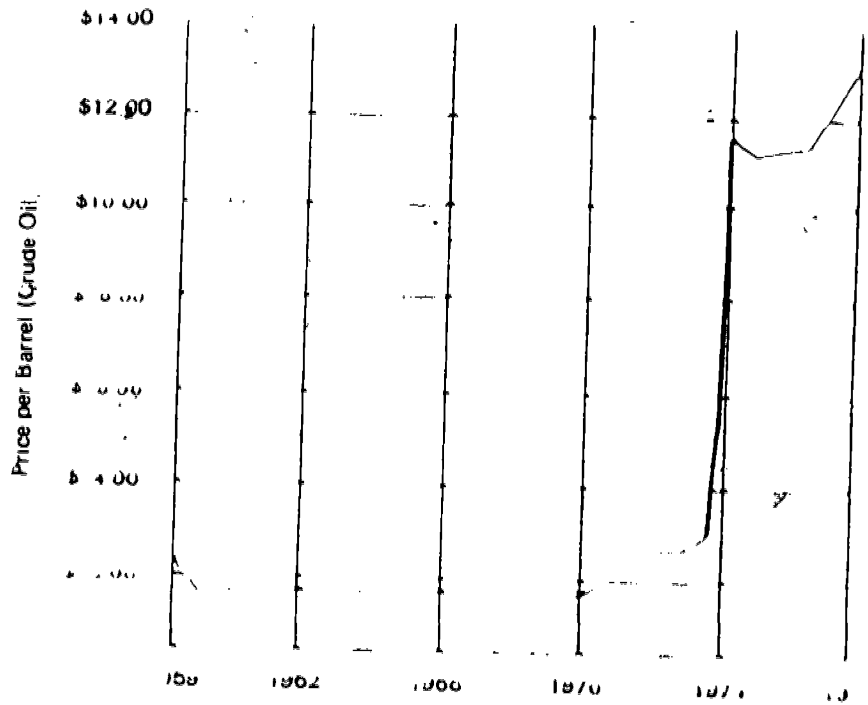


GRAPH 2
UNITED STATES OIL IMPORTS



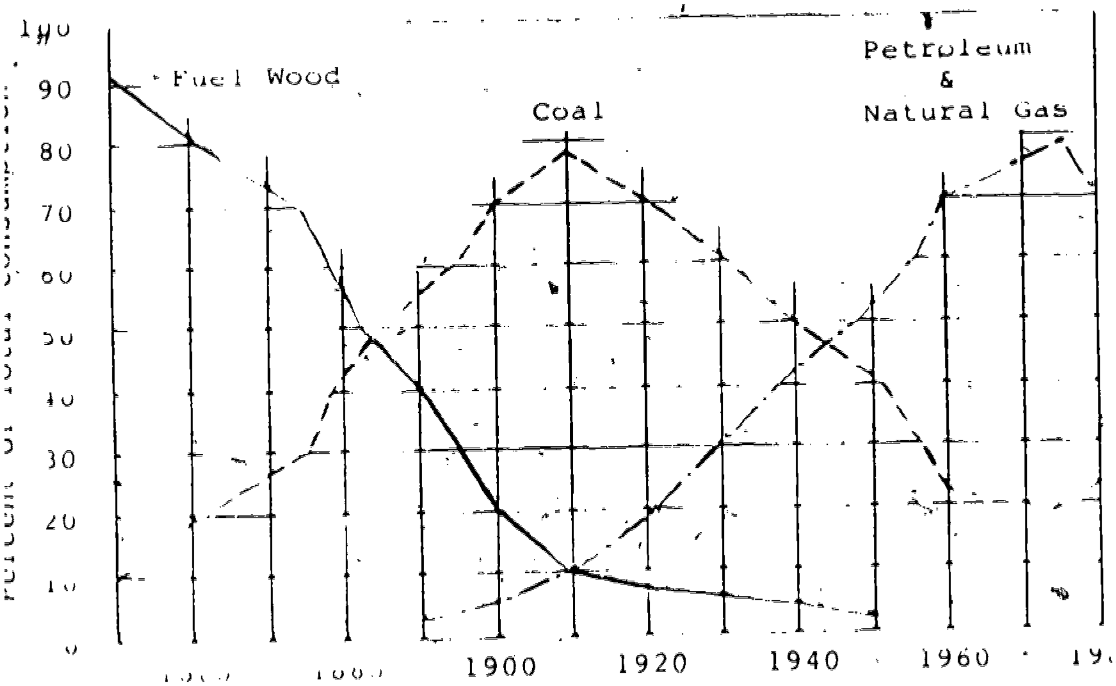
Data Sheet D

GRAPH 3
ARABIAN & PERSIAN GULF CRUDE OIL PRICES



Data Sheet E

CHANGING FUEL SOURCES IN THE UNITED STATES



DATA SHEET F

The Development of the Automobile

The development of the internal combustion engine was a result of inventions occurring in Germany, France, Great Britain and The Netherlands, but its application to the automobile took place in the United States. Henry Ford, an ex-watchmaker who turned to tinkering with automobile engines and putting together automobiles from junked bicycles, forever changed American industry when he introduced standardized parts and mass production. This enabled the Ford Motor Company to sell the *Tin Lizzie* for less than $1,000. In 1905, Ford sold 15 million autonfobiles. General Motors organized a competing automobile company in 1908. Perhaps it was the economic business organization rather than any particular invention which catapulted the U.S. into leadership in the automotive field. The following chart illustrates this growth on a worldwide basis.

Country	Motor Vehicle Registrations 1934	[illegible]
U.S.	[illegible]	[illegible]
USSR	33,500	920,[illegible]00
Britain	[illegible]108,801	[illegible]43[illegible],193
Japan	53,000	1,[illegible]72,359
France	[illegible]100,240	[illegible]960,000

The U[illegible] [illegible] largest [illegible] U.S. [illegible] [illegible] export [illegible] Federal Republic of [illegible] [illegible] exporter [illegible]

[illegible]

[illegible]

[illegible] transportation [illegible]

[illegible] transportation [illegible]

[illegible] and changes [illegible] field [illegible] revolutionized the [illegible] the United [illegible] world. Following is a data sheet on the growth of the automobile industry, and two descriptive essays that provide a view [illegible] past and present.

What to Do

1. Read the selection on the Tin Lizzie. Discuss the local effects of the automobile. Conduct a series of interviews with:

   a. Senior citizens who could describe the changes the automobile brought into their lives.

   b. Trucking industry personnel to obtain insight into the importance of the trucking industry, its role in Pennsylvania, and its current problems

   c. Railroad personnel to determine the strengths and weaknesses of [illegible] form of transportation

2. Read the selection on The City of Windshields and Data Sheet 1 [illegible]. From these, determine

   a. What conditions [illegible] importance to the automobile industry

   b. Why there is such a difference between [illegible] the U S S R

   c. The problems [illegible]

   d. What can be said about the [illegible] industry, both in the present and the future?

3. [illegible] transportation in the United States. The following [illegible]

   a. [illegible]

   b. [illegible]

   c. [illegible]

   d. [illegible]

   e. [illegible]

   f. [illegible]

   g. [illegible]

4. [illegible]

[illegible]

5. [illegible] have [illegible] used to replace the [illegible]

Activity I-4.

Objectives

1. Students will be cognizant of the effect of historical events on the progress of technology.

2. Students will be able to understand the trade-offs necessary to effect technological change.

What to Do

Read the following article on [illegible] to history texts regarding the events of the past 50 years may be necessary.

Teacher Notes

The [illegible] plus the United States' policy of [illegible] economic bas[illegible] nations allowed many foreign industries to [illegible] their [illegible] efficient machinery. Students may have to be referred to history texts to develop these insights and even then the teacher will have to guide this discussion.

[illegible]

[illegible]

[illegible]

Today [illegible] of the [illegible] far out.

[illegible] Most [illegible] were [illegible] side the railroad tracks were [illegible] market their cash crops and livestock.

A typical [illegible] thriving trade center to people living [illegible] two drugstores, [illegible] variety and general merchandise [illegible] a lumberyard, a livery stable, a blacksmith shop, a garage, [illegible] the rail side facilities mentioned above.

It also had its own school system from first grade through high school. No transportation was provided for students. Those living beyond reasonable walking distance rode horses before the car became commonplace. Students from outside the school district (approximately two miles square) paid a monthly tuition. The town elected its own school board, voted, and collected taxes.

The average family living in a small town was land-locked. Its only means of travel to another point was by the railroad. It had no need for horses for work purposes and would not think of going to the expense of maintaining them for an occasional Sunday afternoon ride in the country. Adult residents of the small towns were work-oriented. Vacation trips and leisure were terms with which they were relatively unacquainted. The workweek consisted of six very long days, and Sunday was needed to rest up for Monday. Consequently, there was practically no opportunity for leisure as we know it.

Between 1910 and 1920 the manufacture of automobiles underwent enormous growth. [illegible], the automobile had been largely a novelty — a sort of plaything for the well-to-do. A number of things began happening almost simultaneously. Many people got into the business of today [illegible] like Ford, Dodge, Chevrolet, Buick, Oldsmobile and Cadillac. Competition plus the success of Henry Ford in producing a low-cost practical car (the Model T) placed automobile ownership within reach of the average family, leading to a dramatic change in American life.

[illegible] financing system [illegible] the monthly [illegible] plan.

The people responded with enthusiasm and soon [illegible] some manner [illegible]. The availability of a car [illegible] model old [illegible] was previously impossible or impractical suddenly became both possible and practical. [illegible] automobile made [illegible] possible and provided the flexibility of going to the [illegible] without being dependent upon rigid train schedules. In many instances the round trip between two towns only ten miles apart could not be made by train without an overnight stay. Suddenly, such a trip could be made in less than one hour each way.

the school bus. The bus, combined with the highways, brought consolidation of school districts. But more than schools have been consolidated. Markets, churches, community boundaries, social and recreational activities have all been affected. Just as an old washboard serves as testimony to the existence of a day before the electric washing machine, many small mid-western towns stand as eroding monuments to the era before the automobile.

THE CITY OF WINDSHIELDS

[illegible] excerpt taken from *The* [illegible] The article shows the effect of the automobile on Los Angeles, California.

Los Angeles [illegible] [illegible] is the general and unavoidable means of transportation [illegible] percent of travel in the metropolitan area is done by car. It is estimated that there is one automobile for every 2.5 people, compared with 3.5 in Detroit, the automotive capitol of the United States. And these cars are in daily use, bringing wage earners to their jobs, children to schools and shoppers to local stores. Roughly 60 percent of the central city's land is devoted to parking lots, roads, and garages, in addition to the considerable area that is occupied by its multitude of gasoline and service stations.

[illegible] [illegible] suggests [illegible] that [illegible] to the [illegible] Los Angeles the automobile is not only a means of transportation, but a [illegible] shapes the citizen's sensibility to [illegible] life style, and concept of space and time. So committed is the Angelino to the motor vehicle that a proposal to build a mass transit system for the city was [illegible] defeated [illegible] To travel fifty or sixty miles to a [illegible] restaurant [illegible] [illegible]

[illegible] Los Angeles [illegible] vegetation [illegible] pollution. The [illegible] [illegible]

[illegible] Angeles [illegible] smog [illegible] [illegible] motor vehicles [illegible] the mountains.

TABLE 1

MODES OF URBAN TRANSPORTATION	FUEL MILEAGE (MPG = miles per gallon)
Automobiles	12 MPG
Bus	[illegible] MPG
Commuter Train	1 MPG
DC Jet	25 MPG

TABLE II

Form of Transportation	[illegible] people	Length of trip	[illegible]	[illegible] for trip (in gallons)	[illegible] person (PMPG)
Car	1	20 mi	12	1.7	1.7
Car	2	20 mi	12	1.7	8.[illegible]
Car	4	20 mi	12	1.7	[illegible]
Bus	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bus	[illegible]0	20 mi	[illegible]	[illegible]	[illegible]
Bus	40	20 mi	[illegible]	[illegible]	15
[illegible]	[illegible]00	[illegible]	1	[illegible]	[illegible]
A[illegible]	[illegible]	20 mi		[illegible]	[illegible]

[illegible]

Energy and Industry

The history of industrial development has been in large measure a history of the substitution of energy, capital, and materials for labor. Energy production itself is a contribution to this trend. It has been long felt that major investments in new energy facilities would, in the words of the Executive Council of the AFL, promote *high employment, a dynamic economy and a satisfying way of life*. At one point in the evolution of American industry, this argument was correct. But conditions have changed and hindsight will not aid future industrial growth.

Future industrial stability and growth will definitely need energy at present [illegible] use but industry already has much of the energy it will need in the future. How can this be?

An important fact of the matter is that the thermodynamic efficiency of U.S. industry is only about 25 percent. Improvements in this ratio of *energy in* and *energy out* is where more usable energy can possibly come from, and improvements in this ratio already exist. West German steel and petroleum industries use only two thirds as much energy per ton of product as do their American counterparts; the German paper industry uses only 57 percent as much energy per ton as the American paper industry.[7] Yet there is much room for improvement in German production processes.

The U.S. [illegible] replaced by new, more efficient equipment [illegible] processing techniques. But where will the investment capital come from to allow our industries to phase in the equipment and processes to more efficiently use the energy they are already provided with?

Industrial [illegible] always [illegible] retooling in industry [illegible] substantial [illegible] supply of capital [illegible] other options.

It has [illegible] industrial [illegible] additional energy [illegible] must be made [illegible] be developed. The transition [illegible] energy and the transition [illegible]

[illegible]

From [illegible] material [illegible] important [illegible] substantial savings [illegible] energy [illegible]

[illegible] res [illegible] energy [illegible] fundamental [illegible]

1. What historical events were instrumental in bringing about industrially efficient plants in Germany (also other European nations and Japan)?

2. If residential and commercial energy consumers are willing to absorb the additional cost to conserve or adopt alternate energy methods (for instance solar applications), why can't industry?

3. What can government do to help encourage industrial process conversion that would provide for a more stable energy future?

4. Capital, sometimes called *stored flexibility*, will [illegible] for any structural transformation. Discuss how heavy investments of capital in energy facilities might limit industrial structural transformation.

UNIT II

ENERGY ALTERNATIVES TODAY

Introduction

The Organization of Petroleum Exporting Countries' (OPEC) decision to impose higher prices for oil has had a profound effect upon the United States. We can no longer take for granted unlimited supplies of inexpensive energy. Perhaps the OPEC action was a blessing in disguise, for the experts in energy have been warning us for some time that many of our non-renewable fossil fuels will be in short supply as industry and population grow.

Our study of history indicates that technology has often solved many problems when the need has arisen. Some of the answers to the energy problem are to use the creativity of the scientific community and the decisions of average citizens and industrialists to:

1. Conserve energy.
2. Develop sources of energy that can relieve pressure on oil and natural gas, especially from renewable resources.
3. Show concern for the economic and political forces that influence energy decisions.

If the only concern were technological development, the problem might be easier to solve. However, technology cannot operate in a vacuum. One of the major problems faced by any technology is pollution of the environment. Only within the last decade have we become aware of the fact that our technology too frequently reduces the quality of life, and may even destroy life if used unwisely. However, technology must be used to solve our pollution problems.

All of these considerations must take into account economic and political factors. The major reason for energy conservation is to produce economic goods more efficiently and with less cost. Energy needs and costs affect individuals as they pay for heat, transportation and goods. Energy costs affect industrial production. Energy cost affects international trade and the balance of payments of a nation. For example, the rising cost of crude oil in the 1970's caused an adverse balance of payments in trade for the United States, and this in turn lowered the value of the dollar on the world market.

Now, this brings up a consideration of political action. The decisions of the Congress to subsidize certain industries, to regulate others, and to form certain tax policies that encourage or discourage certain industries can have a great impact on each of us. Some nations also attempt to control energy resources by nationalizing thier industries.

Energy Conservation

A barrel saved is more than a barrel produced

The potential for dramatic energy conservation remains untapped. Our energy waste in transportation is 85%, in generating electricity about 65%. Overall, 50% of our energy is wasted. We need strong energy conservation measures.

James E. Carter
1976

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Energy conservation is the cheapest, safest, cleanest, most reliable, and largest immediate source of additional energy available to this nation. It is also the most labor-intensive source of energy. Numerous studies document the enormous potentials of conservation.

Investments in improving energy efficiency could reduce energy demand by about 38% (at a savings in energy costs of more than $105 billion) by the year 2000 without altering life-styles. An energy efficiency program, begun immediately, would increase employment by 1.8% by 1985 and by 1.7% by 2000.

Cogeneration is the use of what would normally be considered waste energy to do additional work. One method is to use the waste heat from electrical generation to power other industrial processes, thus offsetting the initial cost of the electricity.

Another type of conservation is called retrofitting (the application of *technical fixes* to energy systems) has realized significant savings. At the Ohio State University, energy management and retrofitting were applied to six buildings. This program cut natural gas consumption by an average of 61% and electricity consumption by an average of 31%. Expected savings (at 1973 prices) will be more than $1 million over five years.

Further study of the Swedish energy system conducted by the Lawrence Berkeley Laboratory found that Sweden consumed only 55% as much energy *per capita* as the U.S., althought it's Gross National Product (GNP) and standard of living are comparable to that of the U.S. In addition, Sweden's unemployment rate in 1974 was only 2% compared to 5.6% in the U.S.

Industries have also initiated conservation programs. The 3M Company saved the equivalent of 16 million gallons of oil during the first year of its *in-house* energy management program. After taxes and dividends paid, the dollars saved were used to create 40 additional production jobs.

Energy conservation produces more goods per energy dollar spent. Large amounts of energy waste come from a lack of energy management. But if conserving means producing and installing conserving materials, real savings will still be realized. For example, it costs only $5 to $8 to save a barrel of oil (or its equivalent) which in itself cost about $24 in 1979. And it costs $1.00 to $1.50 to save 1000 cu. ft. of natural gas costing about $3.00 per 1000 cu. ft. in 1979.

The experts in government and private business do not agree on how we will produce energy as oil and natural gas become depleted. But conservation will give us more time to make the right decisions. They do agree that under present economic conditions, the synthesis of fuels from coal or the construction of nuclear generators (especially breeder reactor programs) will produce considerably less energy and jobs when compared to conservation, wven though these may also be needed in the long run.

Activity II-1

Objectives

1. Students will be able to identify varied ways individuals and industry can apply principles of conservation of energy.

2. Students will be able to make valid judgments concerning conservation of energy and substantiate their choices.

What to Do

1. From the preceding reading *Energy Conservation*, and the conservation section of the Introductory Module, have students discuss how the government can encourage residential, commercial, and industrial users to conserve energy.

2. Invite a representative from a utility company to speak to the class about energy conservation and the pricing policies of the company.

3. Using the following format, have the students debate one or more of these suggested topics:

   a. Large users of energy should pay a higher rate than small users.
   b. Government should subsidize industry in modernizing their plants to save energy (and money).
   c. Towns should support recycling processes rather than merely picking up trash and disposing of it.

The Advocates: A Social Science Forum

This classroom program is designed to involve the entire class in the discussion and/or decision-making process on topics related to energy and the environment. The teacher should assign a research team to each side of an issue and this team will supply its Advocate with information which supports that side's position on the issue. Two members of each research team will serve as *professional witnesses* and may be cross-examined by the opposing Advocate.

At the end of the forum, the class will secretly vote on the issue presented, pro or con. The students should be asked to briefly write down their reasons for supporting one side or the other. They should be asked to point out particular strengths and weaknesses of each argument.

Students will get an opportunity to study the issue for an affective purpose and each should be given a different role in the process throughout the year.

THE ADVOCATES

A SOCIAL SCIENCE FORUM

A discussion will be led by an impartial moderator (the teacher) whose job shall be to allot time to the two Advocates who will present and argue their positions on the topics. Each Advocate will introduce his professional witnesses (students) who will testify on the topics relevant to the issue being discussed.

FORUM SCHEDULES:

The teacher will briefly introduce the topic for discussion.

Advocate #1:	Opening remarks	3 minutes
Advocate #2:	Opening remarks	3 minutes
Advocate #1:	Witness #1 testimony	3 minutes
	Adv #2 cross examination	2 minutes
	Adv #1 rebuttal	1 minute
	Witness #2 testimony	3 minutes
	Adv #2 cross examination	2 minutes
	Adv. #1 rebuttal	1 minute
Advocate #2	Witness #1 testimony	3 minutes
	Adv. #1 cross examination	2 minutes
	Adv. #2 rebuttal	1 minute
	Witness #2 testimony	3 minutes
	Adv. #1 cross examination	2 minutes
	Adv. #2 rebuttal	1 minute

Closing Statements

Advocate #1	2 minutes
Advocate #2	2 minutes

The teacher will at this point instruct the students (the jury) to write their comments on the proceedings and to vote for Advocate #1 or Advocate #2.

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Activity II-2

Objectives

1. The students will describe the main sources of energy today.

2. The students should suggest possible new energy sources and give the advantages and disadvantages of each source.

What to Do

1. Have the students read pertinent information such as that presented in "Energy: Its Present Sources" in the Introductory Module. Then have them plan for the use of an alternate source of energy. The students should decide how they would allocate money for the development of future energy resources. Have the students compare their ideas.

2. Have the students read the selections "Available Solar Energy" and "Sun Day." Compare them with the selection on solar energy in the Introductory Module. Find out how much money the government is providing for nuclear energy development and solar energy development. Do students agree with the government in the funding priorities? If not, have them contact their local Congressman and present their viewpoints.

Available Solar Energy

Of the 1.5 quadrillion (10^{15}) megawatt hours of solar energy arriving at the earth's atmosphere each year, about 47% reaches the earth's surface. No country uses even as much energy as the amount that strikes just its buildings. In fact, the sunshine that falls on U.S. roads alone contains twice as much energy as does the fossil fuel used annually by the entire world. Wind power available at prime sites could possibly produce several times more electricity than is currently generated from all sources. Only a small percent of the world's hydro-power has been tapped if low-head hydro sources are developed. And as much energy could possibly be obtained from biomass each year as fossil fuels currently provide.

If all of these sources of energy are available, why haven't they ever been developed? They have, but solar energy has been displaced by cheaper fuels. Until replaced by cheap natural gas (which will be gone soon), solar water heaters were used in California and Florida; in the early 1950's Miami had over 50,000 solar water heaters. In this century, 50 hp. solar pumps have been used for irrigation in Egypt; small solar desalination plants are operating in central Asia, providing much needed fresh water. These applications are not competitive generally, but as fuel costs continue to rise rapidly they will become sensible alternatives.

Advocates for solar power argue that the time for the large scale implementation of this technology is now. The proper investment of our energy capital (both dollars and BTU's) in solar conversion systems will have widespread economic benefits. The present and future environmental

costs of conventional energy systems, such as surface mining and reclamation, power plant fuels and stack gas scrubbing, oil pollution clean-up, and the safe disposal of long-lived radioactive wastes, are only now being figured into the *real* cost of these systems. In the case of the nuclear industry, the costs of waste disposal and plant decommissioning have hardly been addressed.

Solar advocates further point out that unlike finite fuels, sunlight is "a flow" not a "stock." Once a gallon of oil is burned, it is gone forever; but the sun will continue its flow of energy to the earth for billions of years. Technical improvements in the use of solar energy could possibly lower prices permanently; similar improvements in the use of finite fuels can only hasten their exhaustion and hence make the technological transfer to solar technologies more difficult and more costly at a later date.

Conventional energy costs have already begun to rise rapidly. As a result, solar energy is shaking off its present economic constraints and is demanding more of the market. In 1976, U.S. companies produced over one million square feet of solar collectors. In 1977 this number of solar collectors produced tripled.

Much solar energy finding its way into the market today is aimed at use by homeowners or local industries. Passive solar heat and water heaters represent examples of this type of technology. As such, their market can be decentralized and use local resources and labor. It is obvious that refitting existing buildings is more costly than planning for solar heating in new structures. The geographic and climatic location of buildings plays a major role in determining the possibilities of using solar energy. The solar energy industry is in its infancy and we must use imaginative planning and research for it to fill its potential.

Larger scale solar projects such as "solar farms" or "power towers" will be more appropriate for related urban areas in the Southern "sun belt." There is also a bright future for solar furnaces in many industrial processes requiring temperatures of up to 280 degrees Celsius.

Essentially every feature of a proposed solar technology transfer is totally feasible. If a substantial technologic transfer does not occur within the next fifty years, the road blocks will have been policital - not technical.

SUN DAY SPIRIT SHINES ON

(The following was adapted from an article prepared by Beth Wagner of the Center for Renewable Resources for Energy & Education.)

Sun Day was an international success. Twenty-five million people in the United States, and thirty-one countries around the world, participated on May 3 in solar celebrations of every description. The message was that solar energy exists now, and from the impressive public participation on Sun Day, the interest to learn more about this safe, clean energy exists now as well.

A recent Harris poll indicated that 94% of the American public favor the rapid development of renewable energy systems. On Sun Day, thousands of schools reflected similar enthusiasm. As a follow-up to this one day event, the organizers of Sun Day conducted a nationwide survey to find out what happened in the school on May 3. State and local Sun Day coordinators all over the country were contacted to discover what kind of solar energy educational curricula and programs exist.

The result of this inquiry was a status report of solar energy education in the schools from kindergarten through college. The most significant discovery of the study is the absence of educational materials about renewable resources. The void affects all levels, but is particularly noticable at the K-9 level. At the college level a few technical training manuals and solar books designed for the general public are used as classroom texts. For younger students, the situation is worse. Although a few states have energy curricula for the K-12 levels, and a few more plan to develop them, the materials are usually general discussions of energy which relegate solar to a miniscule section at best.

For the most part, energy curriculum developers have failed to take advantage of the entertaining aspects of studying solar energy. Sun Day activities illustrated how easy and fun solar experiments and projects are to perform. Teachers and students alike, in many disciplines, continually expressed how much they enjoyed and learned from the activities.

A final point revealed by the survey concerns decentralization, a characteristic common to schools and solar energy. Sun Day school activities embodied this individualistic spirit. Events, contests, and projects were sponsored on the local level and by individual institutions.

The study of solar energy education was conducted by Solar Action, Inc., the organizers of Sun Day. Since Sun Day, Solar Action, Inc. has reorganized itself into two new groups, the Center for Renewable Resources, and the Solar Lobby. Both are based in Washington, D.C., and will be coordinated by Denis Hayes, author of **Rays of Hope: Transition to a Post-Petroleum World**, and Richard Munson, national Sun Day coordinator. Inquiries should be addressed to the Center for Renewable Resources, 1028 Connecticut Avenue, N.W., Washington, DC 20036.

Activity II-3

Objectives

1. Students will compare the advantages and disadvantages of labor-intensive energy actions and capital-intensive energy actions.

2. Students should provide reasons for monopolistic practices in the energy field.

3. Students should be able to explain the need for government regulation in the energy field. They should use problem solving techniques to try to determine how much regulation should be placed upon the energy industries and suggest alternative ways of insuring this check on economic power.

4. Students will be able to compare varied types of energy resources and determine whether their use could better be handled globally or locally.

5. Students will be able to provide examples of the inpact of military growth upon the energy scene, i.e.,

   a. Awareness of the amounts of energy consumed by the military that does not lead to a higher quality of life.
   b. The interactions between military research and civilian energy research.

What to Do

1. Read the selection "Will the Energy Program Provide Employment?" Then divide the class into the following committees to survey their community on attitudes toward easing the energy problem by relying more on labor-intensive practices:

   a. Group 1–survey parents
   b. Group 2–survey hardware stores
   c. Group 3–survey local business that might take measures to conserve energy
   d. Group 4–undertake research concerning manpower needs of producing energy from coal, oil, nuclear, and solar power.

2. Have students read the selection "Who Controls Energy" that follows and "Energy: Policy and Prospects" from the Introductory Module. Then invite a representative from the Public Utility Commission to speak to the class on the problem of establishing rates. Have some of the students compare their families' electric bills over the past several years. Determine the following:

   a. Why have utility costs escalated?
   b. What was the extra surcharge?
   c. What is the energy charge? How is this established?
   d. A few years ago, the electric companies encouraged the use of electricity by providing reduced rates to heavy users of electricity such as all-electric homes. Now there is a movement to discourage heavy useage by charging extra. This is similar to establishing ex-post-facto laws. How is this justified?

3. Have students investigate different government regulations on industries such as oil, coal and natural gas. Invite an environmentalist to speak to the class on the need for environmental controls. If anyone from the above-mentioned industries is available, have them speak to the class on the merits of deregulation. Finally, have the class act as a Congressional Committee to decide on one issue of deregulation. Invite your local Congressional Representative to sit in on the discussion and react to the class deliberation.

4. Have the students read the article, "Decentralization." With these ideas in mind, two projects can be developed. On the macro level, students should use a world map to locate different types of current and future energy sources. Then have students compare maps and reach a consensus on one project map.

   The other project would concern a micro view of energy in their local community. Have students discuss their community's greatest potential for future energy. Then have students invite a local government official such as a city manager, township supervisor, or city planner in to discuss *Planning for Future Energy Needs.*

5. Have students read "Energy Impact of Military Needs" and do further research on the topic. Have them debate the following:

   a. Reduction of military forces and materials would solve our current energy problems.
   b. Our military-industrial complex is a threat to our democracy and to our public policy on energy.

Will the Energy Program Provide Employment?

Any energy policy that is realistic must consider the influence by and on both labor and capital. Dollars spent on producing new energy sources are more capital-intensive than expenditures on energy conservation. By creating more jobs through conservation efforts, the entire economy may be stimulated and unemployment reduced. For instance, the American Institute of Architects has estimated that it would be feasible to save 12.5 million barrels of oil per day by 1990 if a comprehensive conservation program for new and existing buildings were initiated. Cost for such a program would range from $25.5 to $50.9 billion and would create between 565,000 to 1.13 million direct jobs each year of the program. These people would become more active consumers in the market place. A more prosaic example might be the bottling industry. Twenty-five years ago almost all liquid containers were made of glass, and great labor was expended to collect bottles and sterilize them. As labor costs rose and new plastics and metals became available, throwaway containers became the order of the day. Despite the fact that such a procedure uses energy, litters the environment, and creates a life style that is not conservation-oriented, the profit margin is such that distributors refuse to change unless forced to by law as has been the case in Oregon.

Another example that illustrates a conflict between capital- and labor-intensive industry would be the coal industry. Early mining efforts relied predominantly upon deep shaft mines and the employment of vast numbers of men to mine coal. The conditions were often dangerous, unhealthy, and psychologically damaging. But jobs were available, and many immigrants were encouraged to come to America to work the mines. Eventually the miners rebelled at the deplorable conditions and John Mitchell organized the powerful United Mine Workers of America.

Today, the most fertile coal fields in the nation are in the Rocky Mountain states, and most of the coal will be strip-mined by huge, expensive machines. Labor will be limited and skilled, and few have organized within labor movements. Thus, despite the obvious fact that coal will once more become an important source of energy, it is doubtful if this will have a significant impact on employment.

Who Controls Energy?

Much of the energy produced in this country is supplied by businesses that have a monopoly on a portion of the energy market. Most producers of electricity have been given a monomply by state or federal regulatory bodies. The apparent reason for this monopoly is that such industries require vast amounts of investment capital, equipment, and labor. To off-set the high level of capital investment and costs of operation, companies need a large and secure market for their goods or services. Also, the scale of operation (and the market) must be large enough to make the service economically affordable to the customer. Electric and gas utilities are examples of such operations. Their service areas are large enough to pay back the high costs of operation and expansion, while still (hopefully) making their service affordable.

Monopolies lack competiton, which is the capitalistic principal that maintains low prices and good service. In Pennsylvania the electric utility industries are provided with a *natural monopoly*. Such natural monopolies are given exclusive area franchises by the government. In return for a guaranteed market, the government reserves the right to regulate the operations of these monopolies, to prevent abuses of each monopoly's power, and to guarantee the provision of services at the lowest possible cost to the consumer.

It would be extremely wasteful for a community to have a number of gas or electric utilities competing for the same market. Companies must build generators or pumps, and provide environmental controls and a distribution system. They also must have excess capacity to meet peak demands during times of extreme cold or heat. This requires additional capital equipment. The regulated monopoly maintains the balance between these operational costs and an adequate market which still allows for relatively low unit costs of the service.

Regulated Monopolies

The prices or rates that public utilities can charge are determined by a Federal, state, or local regulatory commission or board. In Pennsylvania, this is the Public Utility Commission. It is assumed that, left unregulated, gas and electric utilities would charge a unit price that exceeds average total cost and that the monopolies might enjoy substantial and *overt* profits. Regulation also assures a sufficient allocation of resources to secure production or service needs for the future. By regulating unit costs, the regulatory agency has eliminated the monopoly's incentive to restrict output in order to benefit from a higher price. (Oil companies have been accused of this very manipulation of supply to encourage higher prices.) Since most utilities are investor owned, regulatory agencies allow for a *fair return* on the investment. Therefore, utilities charge through a *cost-plus* formula. The regulation of utilities is a complicated and costly problem, but the basic point is that regulation can improve upon the results of monopoly from the social point of view. Price regulation can simultaneously reduce prices, increase output, and reduce the economic profits of monopolies.

However, not all sources of energy are regulated, merely the power plants that provide electricity and businesses such as the telephone company and the water companies. The suppliers of fuels such as natural gas and oil have had some regulation. However, there is currently a move to deregulate some of these industries to encourage exploration of new gas and oil fields. It is also theorized that the increased costs of fuel that would occur by deregulation would tend to increase conservation of that fuel. However, it also means that the cost of transportation would become prohibitive for many people. Another example of government regulation has to do with

environmental concerns. The use of more coal as a substitute for oil and gas is a prime example. Certainly, environmental concerns must be balanced with the development of energy sources. These are political decisions that will affect each of you.

Another serious problem of monopolies within the energy field is the existence of huge multinational corporations, especially in the oil industry. Giants such as Exxon, Shell, and Mobile not only influence gas and oil prices, but are expanding their control over coal fields, uranium deposits, and even solar energy. There are practical reasons for such actions. Some of the non-renewable resources are limited in supply and require large sums of money for development. Many of these resources are located in developing nations and the technological expertise and heavy capital investment must be supplied by companies with firm financial resources. Also, since we are living in an interdependent world where multinational corporations extend beyond national boundaries, too strict a regulation might remove American industry from a competitive advantage.

In the field of solar and nuclear energy, there is the problem of high research costs. To encourage this research, the government has allocated funds to assist industries in this development. Not only do the larger companies have more influence on the government for obtaining these funds, but they are often able to sell themselves as a *better bet* since they already have the skilled workers and the capital investment to support such ventures. Thus, government not only regulates but subsidizes large businesses.

What is the problem? If a small number of multinational corporations control the major sources of fuel, there is a danger that they can control not only costs but also development procedures and the thrust of energy research in the future. The main purpose of business is profit, which is not necessarily compatible with the greatest public good.

Decentralization

It is often said that in competitive modern manufacturing, size is of the essence. But a surprising fraction of existing manufacturing facilities are relatively small. In the U.S., just 3% of all corporations own one-sixth of all plants and employ about three-fourths of all workers. The number of employees averages 203 per plant. Excluding some assembly line plants (for example, the auto indsutry and electrical equipment manufacturing plants), average employment per plant is about 100 persons.

What does all this have to do with energy?

With technologies presently under investigation, it may be possible for some industries to obtain most or all of the energy they will need from renewable resources. To be sure, there are special cases such as the steel industry where this will not be applicable.

It is important to match industrial or commercial needs to energy quality and quantity. This is also true for decentralized industry. As industry migrates to different parts of the country (and in some cases different parts of the globe), it will attempt to match its energy needs with locally available energy resources. It seems quite logical that areas of the world with abundant sunlight could best use solar energy if the inhabitants' cultural view of life would be able to handle this type of change. Areas with strong steady winds could rely on windmills, while areas close to falling waters have always relied on hydroelectric power. Low-head hydroelectric power shows great promise. (The Soviet Union has long harnessed water power on flat lands by forcing rivers through

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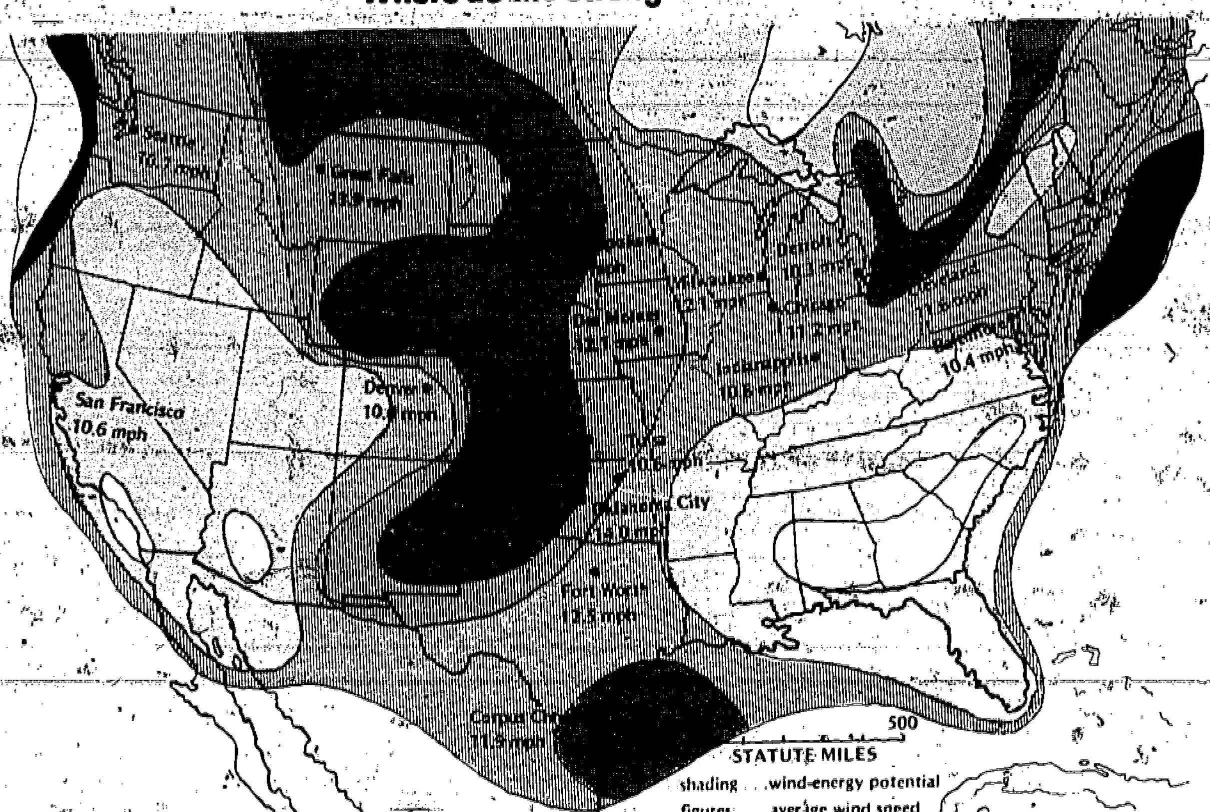
narrow sluices.) All such ventures point to the importance of assessing local geographic conditions and adapting sources that will best meet the needs of local consumers. The future development of these small-scale industries will depend on rising fuel and utility energy costs. Investment in renewable energy systems for industry looks very attractive and is already becoming a reality.

There are also social advantages attending these decentralized industries. Small firms tend to diversity both wealth and social power; they also seldom exert disproportionate influence over governments. Small firms often provide more room for innovation and for genuine worker participation in decisions, and they tend to be a more integral part of their surrounding communities.

Smaller firms also tend to have fewer strikes, better worker safety records, and less sabotage. Perhaps partly as a result of these trends, small firms also tend to generate higher net returns.

Decentralization is not an economic cure-all. Nor is it an appropriate concept for all industrial processes and industry/society interfaces. But there is undoubtedly a future for industries powered by renewable energy sources, and industry will consequently relocate toward parts of each country where renewable energy sources are in greatest abundance. This can be documented historically. Most early American industry clustered close to rivers and streams, but as steam replaced water power, population shifted. However, a well-thought-out and planned energy policy that looks to the future can reduce population dislocation and encourage a pluralistic energy policy for a diverse world. If and when fusion becomes a reality, all areas of the world might have access to abundant power. But between this hope and the realities of today's energy crisis it will be imperative for the citizens of the world to develop an understanding of the energy problems, seek alternatives and exert influence on our political and economic decision makers.

Where do the strong winds blow?



The Energy Impact of Military Needs

The huge military budgets in the world have two specific impacts upon energy. The first has to do with conservation. Military armaments represent nonproductive goods. If capital is invested in steel mills, tractor plants, or computer laboratories, this money results in production of goods and services. Money that goes into the production of guns, ammunition and tanks, results in no new production. Unless these materials are used in war, they become obsolete. Thus huge amounts of energy are burned up on nonproductive means.

As noted in the Introductory Module, nuclear weapons defense programs have produced about 500,000 tons of highly radioactive wastes. The half life of these wastes extends further into the future than our history of civilization extends backward. As the nuclear arms race continues, the amounts of these radioactive wastes will undoubtedly increase, and so far there is little agreement where and how they may be safely stored.

This is not to say that any nation can afford unilateral disarmament. A major function of a government is protection of its people. However, the sophistication of armament and the huge increase of arms sales not only drains dwindling energy resources, but also encroaches on budgets that could easily be allocating more for energy research. For instance, in FY 1978, 25% of the Federal budget or $116.4 billion was spent on defense. Another way energy is depleted is the vast amounts of fuel used to power military vehicles, such as planes, tanks, ships, and trucks.

An indirect way the military budget affects energy is the special funding going to nuclear research. It is difficult to separate the funds used for peaceful or military nuclear experimentation, but there is little doubt that one supports the other, and a huge vested interest was created that has influenced government energy policies. President Eisenhower warned of the dangers of the military-industrial complex.

The only nation in the world to officially repudiate war has been Japan. Article IX of their constitution, which was influenced by General MacArthur and the American Occupation Forces, forbids the buildup up of military forces except for a small defense force. Only 0.85% of the GNP in Japan is used for security forces. The United States spends 6% of its GNP on defense. Although there is not a direct correlation between these figures, it is a fact that the Japanese have had more money to invest in productive industry. Although they are energy and resource poor, they have expanded into the third largest economic power in the world since World War II.

UNIT III

ENERGY A GLOBAL PERSPECTIVE

> The Earth looked so tiny in the heavens that there were times during the Appolo 8 mission when I had trouble finding it. If you can imagine yourself in a darkened room with only one clearly visible object, a small blue-green sphere about the size of a Christmas-tree ornament, then you can begin to grasp what the Earth looks like from space. I think that all of us subconsciously think that the Earth is flat or at least almost infinite. Let me assure you that, rather than a massive giant, it should be thought of as a fragile Christmas-tree ball which should be handled with considerable care.[1]
>
> Astronaut William A. Anders

There are many views and opinions concerning the global energy situation. The Social Studies disciplines lend themselves particularly well to the study and discussion of the global energy problem. To have the student understand the interdependence of nations as far as the world's energy supplies are concerned, it is necessary to visualize where the world's energy reserves are located.

The less developed nations of the world have 50% of the world's population, but use only 2% of the world's energy. The United States has about 6% of the world's population and consumes almost 33% of the world's energy. As the population of the poor, less-developed nations continues to grow, what role will the cost and availability of energy play on world politics? How drastically would the standard of living in our nation be affected if the supply of energy were to be distributed to the nations of the world on a per capita basis?

While we tend to think of energy in some of its more traditional forms, such as oil, coal, hydroelectricty, and wood, it must be remembered that there are other forms of energy to be developed globally. Some of the less developed forms of energy are solar, wind, and geothermal energy.

The nations which produce and use the greatest percentage of electrical energy are not among the world's most populous nations. In many nations, the expanded use of nuclear energy is viewed as a method of releiving the energy crisis, but the negative as well as the positive factors involved in building these reactors should be considered.

The Middle East has a major influence on the oil-consuming nations of the world. The 1973 oil embargo and the cut-off of Iranian Oil exports in 1979 have affected economic, social, political, and military policies throughout the world.

It is fairly simple to realize the effects that a cutback in oil supplies has had in our own nation, but many fail to realize that the poor nations of the world are often more drastically affected by such cutbacks.

In many nations the poor would be faced with the prospect of not merely cutting down on the amount of oil used to heat their homes, but with going totally without heat for their homes or

[1]Benjamin F. Richardson, Jr., **Introduction to Remote Sensing of the Environment** (Dubuque, Oiwa: Kendall/hunt Publishing Company, 1978), p. 2.

fuel for cooking. Since an oil derivative is used in making fertilizer, the oil cutbacks also have effects on the foodstuffs being raised to feed the world's poor.

Many nations of the world are still dependent on firewood and dung (animal refuse) as basic fuels. With the populations of less developed nations increasing, the forests of these nations being cut back, and oil prices increasing, the outlook for many of the poor nations is rather bleak.

Pollution and an energy-based technology are affecting global climatic conditions, causing the glaciers to melt and the sea level to rise. This could cause a mass displacement of people and materials away from the present coastal areas. How could this displacement affect the world political, ecological, military, and economic situations?

Recently China has located large oil fields off its coast which could greatly change its status and position on the global scene. If Mexico becomes a major oil producing nation, how would the social and economic conditions in the nation change? In want ways can we expect these nations with abundant oil supplies to exert their new financial and political powers? It can be observed that the United States' domestic and foreign policy has significantly been influenced by consideration of the world energy supplies.

We must consider that in the future the nations of the world will have to decide and legislate the control of the energy stored in and under the oceans of the world. The United Nations is vitally concerned with determining the fate of ocean resources and also with the control of nuclear energy, thus the activities of the United Nations and the U S policy within the U N is another area that should concern our citizens

Activity III-1

Objective

The stude[illegible]
the world energy situation

What to Do

Make a collection [illegible]
artists' views and opinions [illegible]

[illegible]

Objective

[illegible]

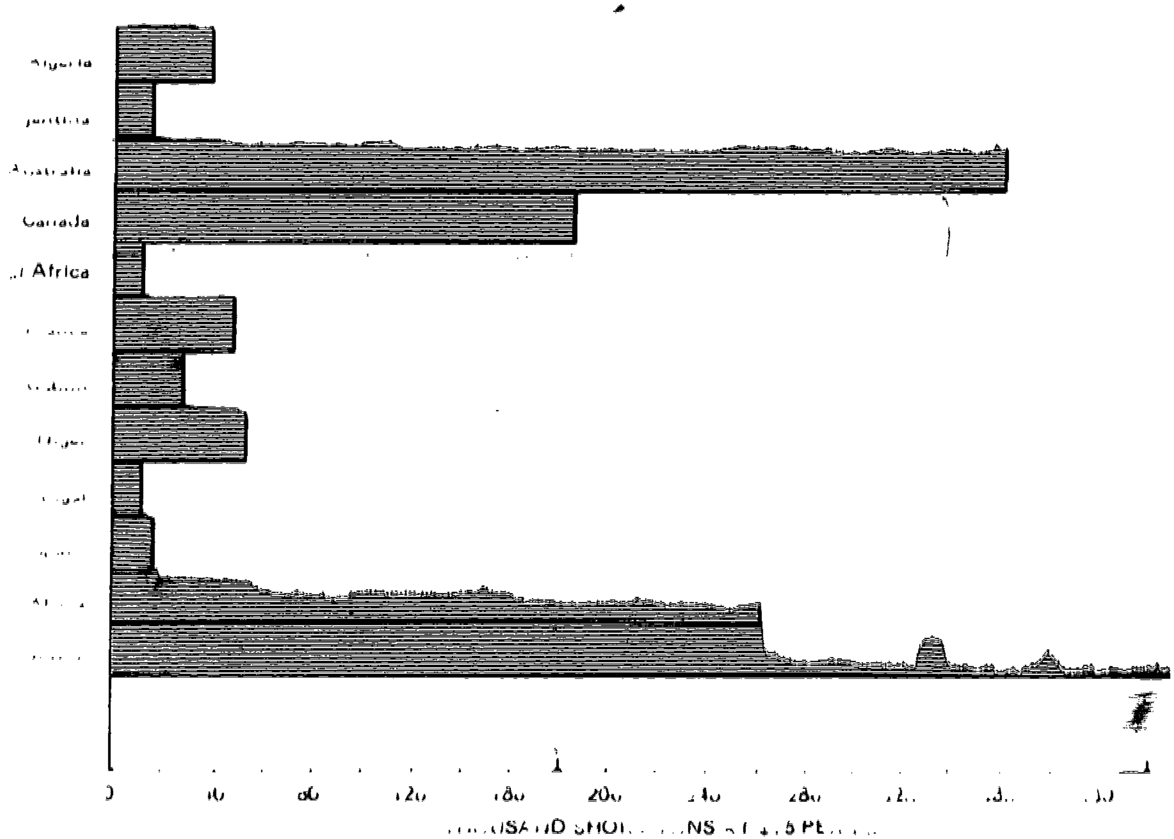
What to Do

[illegible]

	COAL	NATURAL GAS	OIL	URANIUM
United States	2	3	4	1
Other Hemisphere countries			5	Western 4
Western Europe	3	5		5
Africa	5	4	3	3
Middle East		2	1	
Australia				2
Far East and Oceania	4			
Sino-Soviet Bloc	1	1	2	

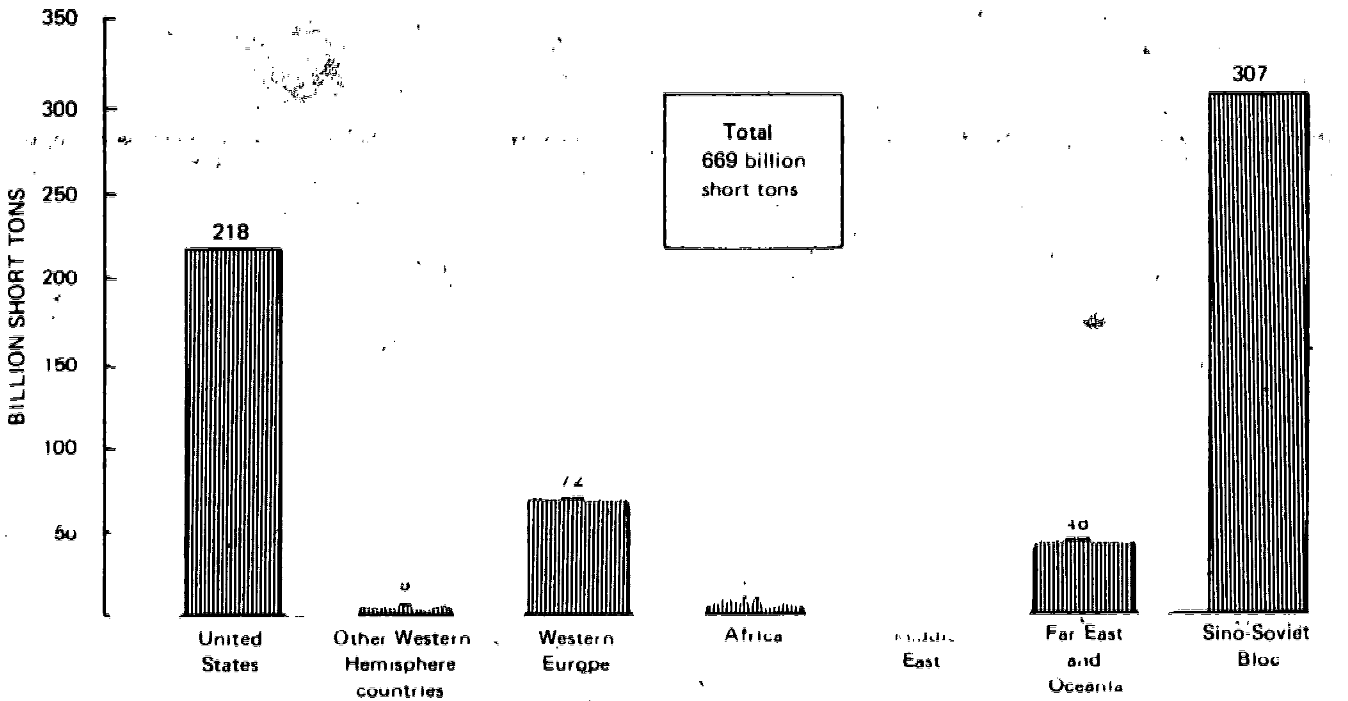
Teacher Notes

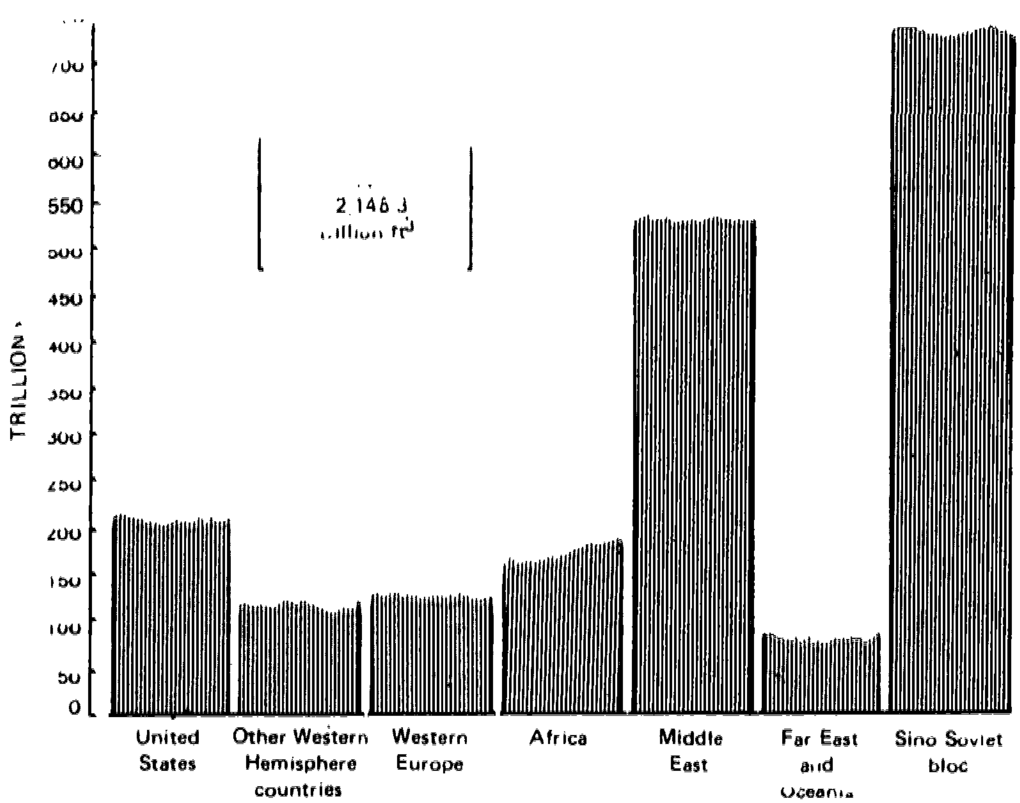
Graphs that follow are from the U.S. Department of the [illegible] June 1976



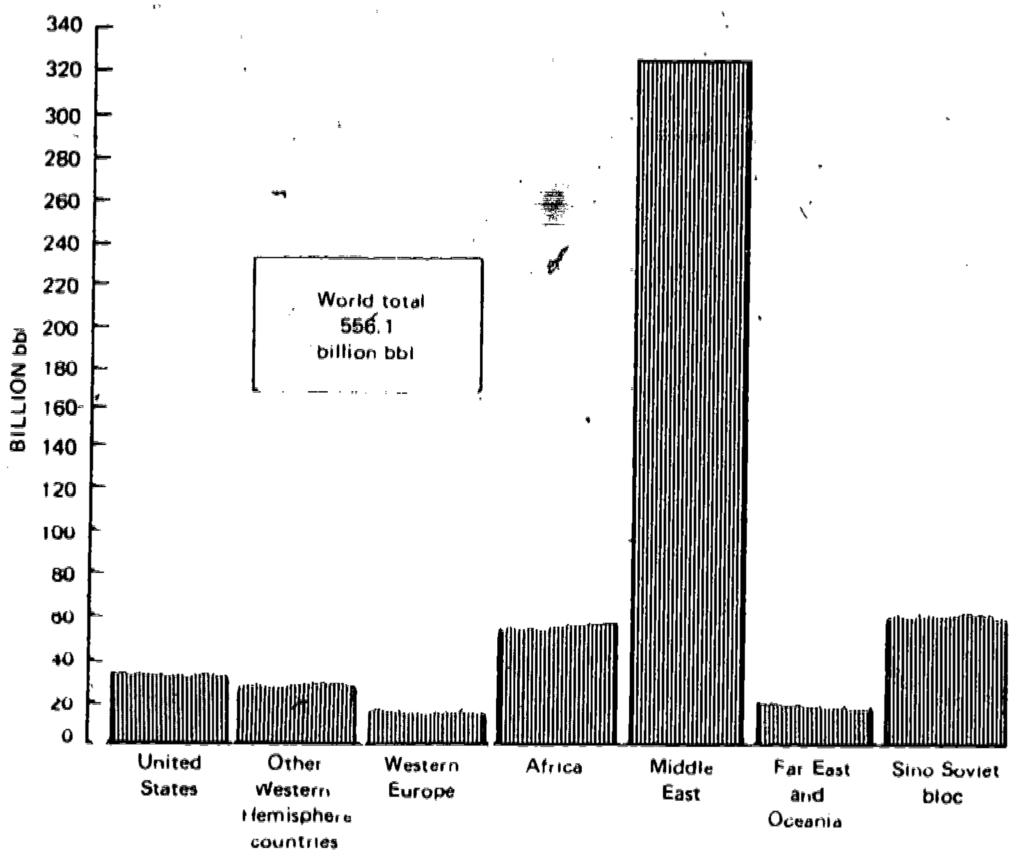
WORLD URANIUM RESERVES 1976

WORLD RECOVERABLE COAL RESERVES, 1974





WORLD ESTIMATED CRUDE OIL RESERVES, JANUARY 1, 1975



Answer

Top Ten Counties

	COAL ANTHRACITE / BITUMINOUS	NATURAL GAS	PETROLEUM	URANIUM
1	Schuylkill Washington	Erie	McKean	Carbon
2	Luzerne Indiana	Beaver	Venango	Columbia
3	Northumberland Greene	Potter	Warren	Lycoming
4	Carbon Clearfield	Warren	Forest	Sullivan
5	Lackawanna Cambria	Westmoreland	Washington	Bradford
6	Dauphin Armstrong	Fayette	Butler	Berks
7	Berks Snyder Somerset	Clinton	Crawford	[illegible]
8	Columbia Clarion	Washington	Allegheny	[illegible]
9	Sullivan Allegheny	Forest	[illegible]	Wyoming
10	Susquehanna Westmoreland	[illegible]	Elk	Lackawanna Wayne

What to Do

1. Make a graph to show the years to depletion of non-renewable resources on Planet Earth.

Non-renewable Resource	Years to Depletion
Coal	300-400
Natural Gas	35-80
Petroleum	20-80
Uranium	60-70

2. Problem. The recoverable fossil fuels for the world are estimated (in terms of 10^{15} kg of C) to be: Coal, 5.7, oil shale, 0.4, petroleum, 0.3, gas, 0.1, tar sand, 0.1, total 6.5×10^{15} kg of C. The U.S., with 6% of the world population, consumes about 3×10^{12} kg of carbonaceous fuel annually. If all the world's population consumed these fuels at the present U.S. rate, how long would the fossil fuel supply last?

   Answer: 3×10^{12} (kgC/yr) x 100/6 = 5×10^{13} (kgC/yr) required if all people used carbon fuels at the same personal rate the U.S. does. 6.5×10^{15} (kg of C) ÷ 5×10^{13} (kgC/yr) = 100 yr of available carbon fuel if the present world population remains constant but suddenly all consume fuel at the U.S. rate. Most authorities assume carbon fuels will last from 300-500 years. This assumes much of the world remains "undeveloped."

   Teacher Notes

   Student should [illegible] at
   Comparison of [illegible] ter[illegible]

Activity III-6

Objective

Students will become familiar with the sources of oil through the world.

What to Do

Have students complete the activity on this page.

Because America's demand for oil is greater than its supply, we must buy oil from other countries to help meet the demand. This is called *importing*. During the last five years our imports of oil have doubled, and the cost per barrel has increased more than four times.

1. Find each country shown on the graph on a world map. Then list each country in its proper region below. Beside each country's name write the percentage of oil the U.S. imports from it.

North America

Latin America

The Mideast

Africa

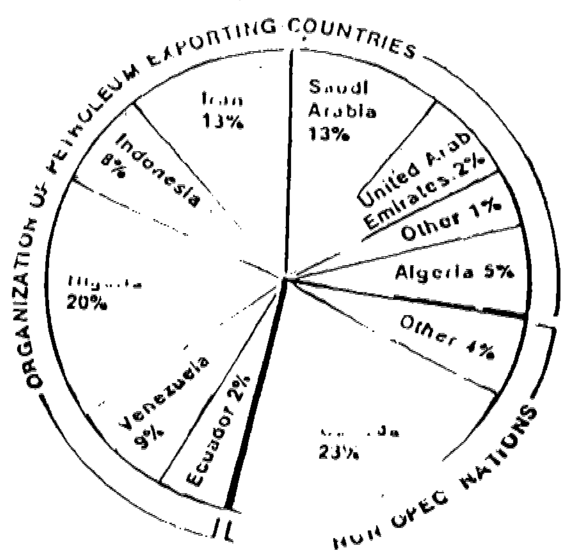
formed an association ... for their crude oil.)

3. What percentage of imported U.S. oil comes from OPEC nations?

4. Which country sells the U.S. the most crude oil? (This country says it will need to end all shipments to the U.S. by 1982.)

5. Why does the U.S. need to import oil?

THE OIL WE IMPORT



Total U.S. Crude Imports

Check which of these solutions to our energy consumption problem seems workable to you.

Increase domestic production of fossil fuels.

Activity III-7

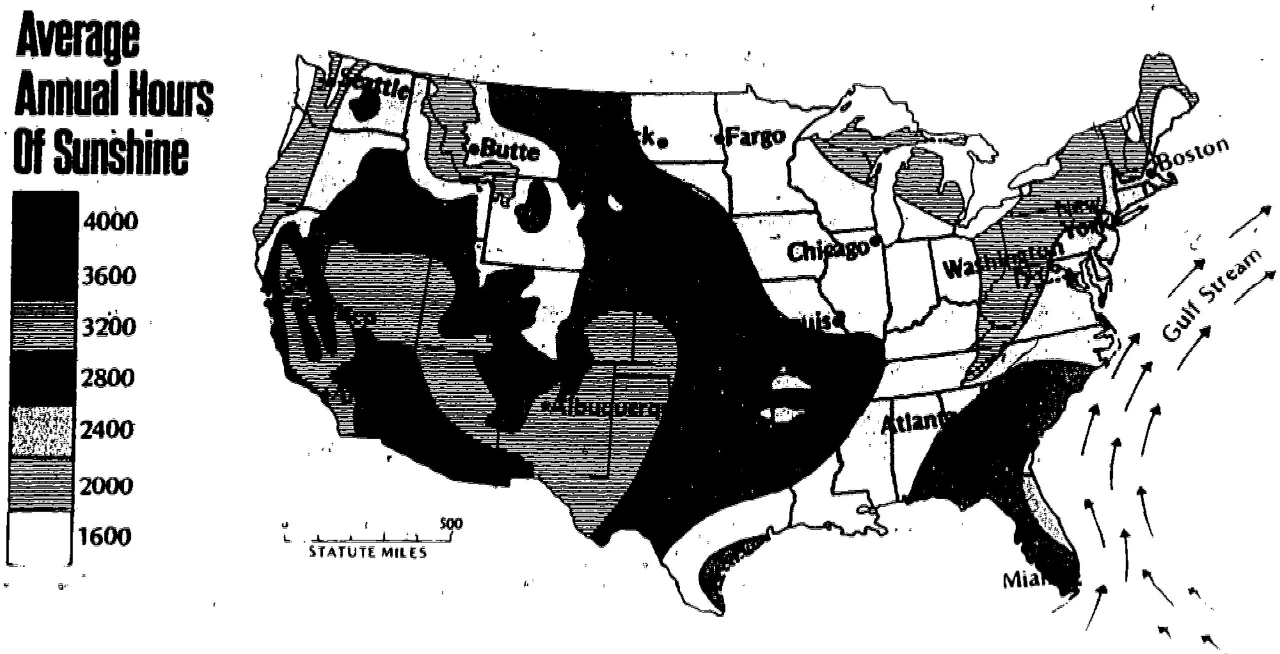
Objective

The student will locate and understand those regions of the world which could use solar and other types of energy.

What to Do

Collect data from weather stations and reference books on the amount of sunshine received in various regions of the world or the U.S. The same activity can be done using the number of degree days, where strong winds blow, etc.

Map the various patterns distributions. Discuss the areas which would have the best potentials for the various energy sources to be practically utilized throughout the world.



Activity III-8 [illegible]

Objective

The [illegible] energy and will compare the populations of [illegible]

What to Do

Using reference materials [illegible] chart and a bar graph, compare the population of the nations with [illegible] production. Ask the following discussion questions.

1. How much electricity would be produced by the nations if they produced as much electricity per capita as the United States?

2. How much electricity would be needed if everyone in the world lived according to U.S. standards?

World Electricity Production
Source: UN Monthly Bulletin of Statistics, July 1977
(1976 production in million kilowatt hours)

United States	2,117,628	France	191,196	East Germany	89,148	Czechoslovakia	62,628
USSR	1,110,960	Italy	160,560	Sweden	84,312	Netherlands	58,056
Japan	475,800	China (e)	112,000	Norway	82,188	Romania	53,724
West Germany	333,648	Poland	104,100	South Africa	80,712	Belgium	47,352
Canada	293,412	Spain	90,600	Brazil[3]	78,072	Mexico	46,236
United Kingdom	276,972	India[2]	89,208	Australia	76,500	Yugoslavia	43,572

(e) Estimate (1) 1974 (2) Excluding generation by industrial establishments (3) 1975

Activity [illegible]

Objective

[illegible]

What to Do

[illegible] plants. Wh[illegible] ? Why aren't more being built?

WORLD'S LARGEST HYDROELECTRIC GENERATING PLANTS

Source: Bureau of Reclamation U.S. Interior Department
UC – Under construction Year – Initial operation

Name	Present megawatts	Ultimate megawatts	Year	Name	Present megawatts	Ultimate magewatts	Year
Itapu, Brazil/Paraguay . . .	------	12,600	UC	Salto Santiago, Brazil . . .	-----	2,000	UC
Grand Coulee, U.S.	2.161	9.780	1941	Robert Moses-Nigara, U.S. .	1,950	1,950	1961
Paulo Alonso, Brazil . . .	1,299	6,774	1955	Salto Grando, Argentina	-----	1,890	UC
Guri, Venezuela	524	6,500	1967	Dinowic, Great Britain . . .	-------	1,880	UC
Tucurui, Brazil	-------	6,480	UC	Ludington, U.S.	1,872	1,872	1973
Sayanskaya, USSR	------	6,400	UC	St. Lawrence Power Dam . .			
Krasnoyarsj, USSR	6,096	6,096	1968	US/Canada	1,824	1,824	1958
La Grande, Canada	-------	5,416	UC	The Dalles, U.S.	1,807	1,807	1957
Churchill Falls, Canada . . .	5,225	5,225	1971	Karakaya, Turkey	-----	1,800	UC
Bratsk, USSR	4,100	4,600	1964	Mica, Canada	-----	1,740	UC
Sukhovo, USSR	-------	4,500	UC	Beauharnoism Canada	1,021	1,670	1950
Ust-Ipimsk, USSR	720	4,320	1974	Kemano, Canada . .	831	1,670	1954
Irha Solteria, Brazil	3,200	4,100	1973	Blue Ridge, U.S. . .		1,600	UC
Cabura Bassa, Mozambique	2,000	4,000	1975	Oatia, Columbia		1,540	UC
Inga, Zaire	350	3,700	UC	Racoon Mountain, U.S	1,530	1,530	1975
Rogunsky, USSR	---	3,600	UC	Kanba, Rhodesia	600	1,500	1959
Inga, Zaire . . .	350	2,820	UC	Tumut-3, Australia .	750	1,500	1972
John Day, U.S.	2,160	2,700	1968	Mambondo, Brazil	1 440	1,440	1975
Nurek, USSR	--	2,700	UC	Jupa, Brazil	1,411	1,411	1966
Sao Simao, Brazil .	----	2,680	UC	McNary, U.S	980	1,406	1953
Volgograd-22nd Congress				Cheboksany, USSR .	1 404	1 404	1972
USSR	2 560	2 560	1958	Aqua Vennelna, Brazil		1,380	UC
Chicoasen, Mexico	- -	2,400	UC	Saratov, USSR	1 360	1,360	1967
Volga V I Lenin, USSR	2 300	2,300	1955	Daniel Johnson Canada	650	1 353	1970
W A C Bennett, Canada .	1,816	2,270	1969	Hoover, U.S.	1,345	1,345	1936
Foz Do Areia, Brazil . .		2,250	UC	Wanapum, U.S	831	1 330	1964
High Aswan (Sadd-el Aali)				Ingun, USSR	--	1,290	UC
Iron Gate, Romana/Yugosl. .	2 100	2 100	1970	Takase, Japan		1,280	UC
Bath County, U S	.	2,100	UC	Priest Rapids U.S	789	1,262	1959
Itumbiara Brazil		2,100	UC				
Chief Joseph, U.S.	1.024	2,069	1956				

(1) Pumped storage . . . . .

WORLD NUCLEAR POWER

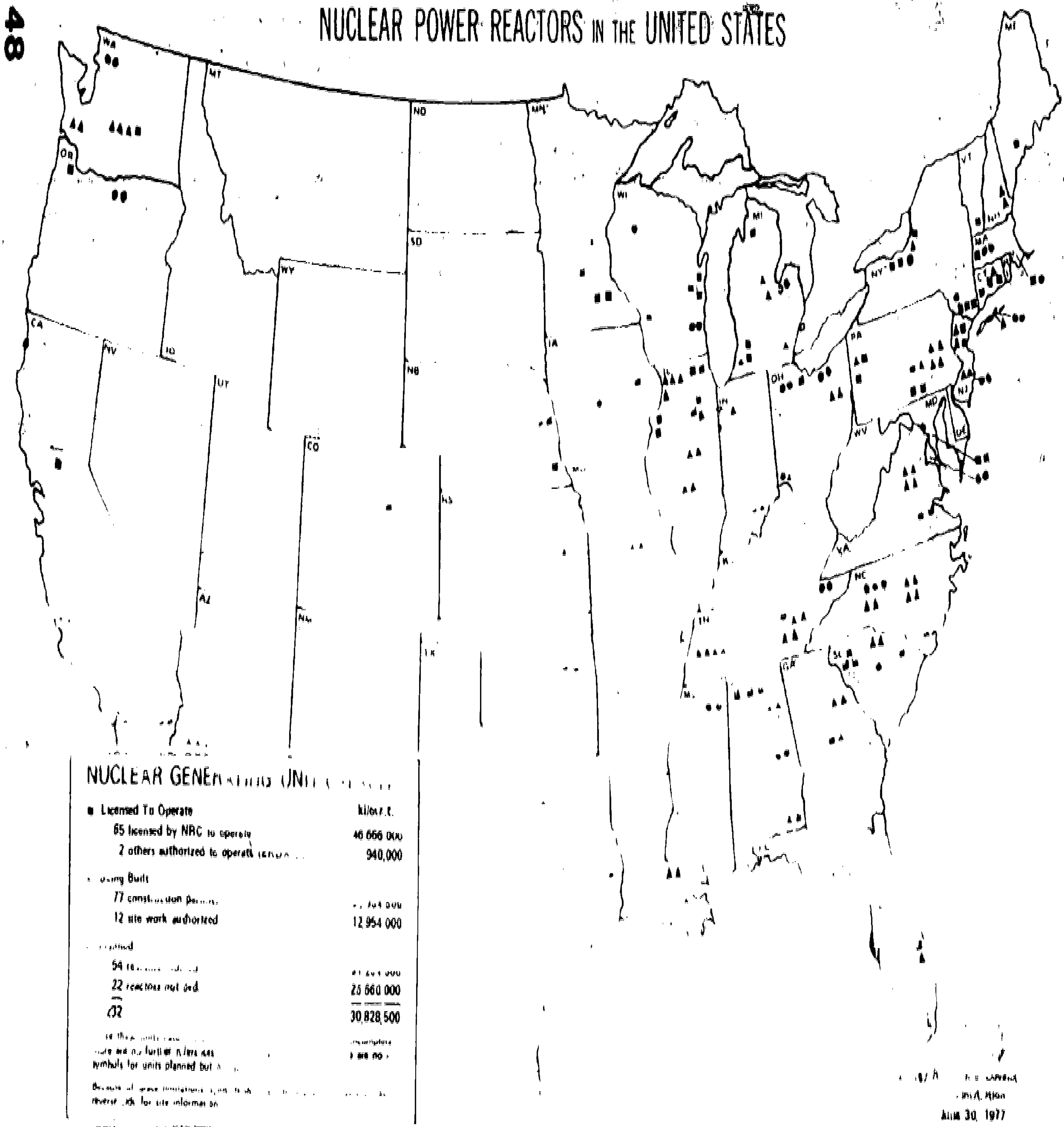
Source: Federal Energy Administration

Country	Operational reactors	Capacity	Generation April 1977
Canada	7	3,930,000	2.08
France	11	3,970,000	1,53
Germany, West	10	6,410,000	3.46
Great Britain	31	7,950,000	3.22
India	3	620,000	0.14
Italy	3	630,000	0.39
Japan	13	7,430,000	1.62

County	Operational reactors	Capacity	Generation April 1977
Spain	3	1,120,000	0.44
Sweden	6	3,880,000	1.73
Switzerland	3	1,060,000	0.76
United States	63	46,090,000	20.40
Total		83,090,000	35.76

(1) Kilowatts (2) Billion kilowatt-hours

NUCLEAR POWER REACTORS IN THE UNITED STATES



Activity III-11

Objective

The student will recognize the impact of an oil spill by looking at three aspects of such a spill: the environmental damage; the loss of energy; the financial loss.

What to Do

Compile a list of the major oil spills at sea to date. Just how large is 69 million gallons of oil? Would it fill your school? How many cars could travel 100,000 miles on this oil? How many homes like yours could it heat for a year?

Make a map of the distribution of oil spills. Make a collection of pictures of the areas and wildlife affected by the oil spills. Ask the following discussion questions:

1. Should there be international controls regulating design and construction of oil tankers?
2. Should requirements to operate and navigate such vessels be stricter?
3. Who should be held responsible for such disasters at sea?
4. Should there be international regulations to de[illegible] the oil in the oce[illegible]?

Record Oil Spills, 1967-1977
Source: Conservation Division, US Ge[illegible]
US Interior Department

Date			Name and Place	Cause	Gallons
1967	Mar	18	Tanker Torrey Canyon off England	Grounding	[illegible] 100,[illegible]
1967	Sept	6	Tanker R C Stoner, Wake Is	Grounding	6 006,000
1967	Oct	15	Pipeline, West Delta, La	Dragging a[illegible]	6,720,000
1968	May	5	Tanker Andron: off W Africa	Sinking	4,914,000
1968	June	13	Tanker World Glory: off S Africa	Hull failure	13,524,000
1969	Jan	3	Offshore oil rig: Santa Barbara, Cal.	Leakage	235,000
1969	Nov	4	Storage tank: Sewaren, NJ	Tank ru[illegible]	[illegible] 400,000
1969	Nov	5	Tanker Keo: off Massachusetts	Hull failure	8,820,000
1971	Nov	30	Tanker off Japan	Ship broke [illegible]	6 258,000
1976	May	12	Tanker Urquiola, LaCoruna, Spain	Grounding a[illegible]	1,941,000
1976	June	23	Barge, St. Lawrence Seaway, NY	Grounding	300,000
1976	Oct	14	Tanker Boehlen, Brest, France	Sunk in st[illegible]	[illegible] 134,000
1976	Dec	15	Tanker Argo Merchant, Nantucket Is, Mass	Grounding	7 700,000
1976	Dec	17	Tanker Sansinena, Los Angeles	[illegible]	[illegible]
1976	Dec	30	Tanker Olympic Games, Delaw[illegible] River	Grounding	133,600
1977	Jan	17	Tanker Irenes Challenge, [illegible] Midway Is	[illegible]	[illegible]
1977	Feb	4	Barge: Hudson River, Bear M[illegible]	[illegible]	[illegible]
1977	Feb	10	Freighter, San Francisco Bay	Val[illegible]	18,540
1977	Feb	24	Tanker Hawaiian Patriot, W[illegible]	Explosion	[illegible]00,000
1977	Mar	3	Tanker Borag: off Taiwan	Hit reef	1 134,000
1977	Mar	20	Tanker Claude Conway: off N[illegible]	Explosion	536,000
1977	Apr	22	Ekofisk oil field, North Sea	Oil well bl[illegible]	[illegible] 200,000

Activity III-12

Objective

The student will illustrate the possible hazards of energy technology and the extensive use of energy as it affects global climatic conditions.

What to Do

Construct a regional or world map showing the altered coastal lines if the sea level were to rise 300 feet worldwide. The figure of 300 feet rise in the sea level is based on the premise that as we pollute the atmosphere, the temperature will rise and global ice will melt. This is conjecture, not a proven fact.

Discuss the effects of energy-related pollution in a possible global climate change. How much energy would be needed to replace and rebuild the major cities of the world?

Make a list of all major cities of the world that would be inundated if this unlikely event were to occur.

Calculate the land area and population which would be affected. The figure should be a percentage of th total global land area and population.

Activity III-13

Objective

The students will visualize the energy use in the U.S. compared to that of the rest of the world.

What to Do

1. The following table shows population and energy use by different categories of nations for the year 1975.

	% world population	% energy use
Less developed countries	50	2
Developing countries	25	13
Industrialized countries	19	40
U.S.A.	6	45

Put slips of paper into a container equal to the number of students in the class. Each slip will be one of four colors representing the four groups above. Have the proportion of the various slips in the container approximately equal to the population figures; for example, one half of the slips should be of the color representing less developed countries, one quarter for developing countries, etc. Have each student pull a slip of paper to determine to which group he/she will belong. Thus the assignments will occur by chance, just as it is only by chance that we live in this country.

2. Take an unsliced loaf of bread and cut it into four sections equal to the percentage of energy consumption. Give the appropriate section of bread to each group to divide among themselves. For example, the U.S. group will receive almost half the loaf, which represents our current use of the finite limits of energy resources.

   Have the class members share their attitudes toward their particular portion and toward the people who had larger or smaller portions.

3. Hold a class discussion on this topic. Bring out the facts about the disproportionate share of energy we use, including the fact that the meat in our diet takes so much energy to produce. Have the students give opinions on whether this is fair. By cutting our own consumption, can we increase supplies for the people who really need it? How is it possible to better the lot of people who live in poverty? Is there anything we can do personally?

Activity III-14

Objective

The student will recognize that the poor nations of the world are affected more drastically by the oil crisis than are the wealthy nations of the world.

What to Do

Make a list of the nations most affected by the oil crisis. Why are poor nations hurt more by the oil crisis? List the major uses for oil in less developed nations.

Ask the following discussion questions:

1. How does the energy crisis affect the world hunger problem?

2. What is meant by the statement *making money by freezing the poor*?

Activity III-15

Objective

The student will realize that some nations are still dependent upon firewood and dung as basic fuels.

What to Do

Locate the nations which are still dependent on wood as a source of fuel. Determine why wood rather than other types of fuel is used. Discuss the alternatives that poor nations have if wood is no longer available. (Between 60 and 80 million tons of dried dung are burned annually in India.)

Discussion Questions

1. How large is a cord of wood? Give the measurements for one cord.

2. How many cords of wood would it take to equal one ton of coal or a barrel of oil?

3. How many years does it take to grow the lumber for a cord of wood?

4. How many cords would it take to heat the average colonial or modern home?

5. How many acres of forest would be needed if a town of 10,000 persons were to use wood for their heating and cooking?

Activity III-16

Objective

The students will examine relationships between life styles and energy costs.

What to Do

Review with the class the fact that gasoline sells for much more than $1.00 per gallon in many European countries such as Switzerland, Holland, Denmark, France, and Great Britain.

Divide the class into groups of three or four students. Ask each group to think about and develop a list of ways in which *life styles* in those countries with high gasoline costs is likely to be different from the ways people live in the U.S.A., where gasoline although expensive, is cheaper than in any other highly industrialized country. Encourage the groups to think broadly beyond such obvious things as size of automobiles and number of superhighways. Types of family vacations, suburban sprawl, status of railroad passenger service, extent of air travel, use of recreational vehicles and many other element of our life style can be shown to be related to energy costs.

Ask each group to make value judgments as to whether the life style in high energy cost countries is worse or better than ours. Ask each group to state its conclusion on one or two specific examples and defend its position before the class.

Activity III-17

Objective

The students will recognize the impact of the energy crisis on international relations.

What to Do

1. Have students research areas of the world which have the largest supply of energy resources. Also have the students determine areas of the world which are the greatest users of energy. Graphs and maps would be very appropriate.

2. Have the students draw possible conclusions concerning the effect of the present energy situation on American foreign policy. Discussion should include the Middle East, Latin America, Southeast Asia, the Soviet Union, Red China, and Europe.

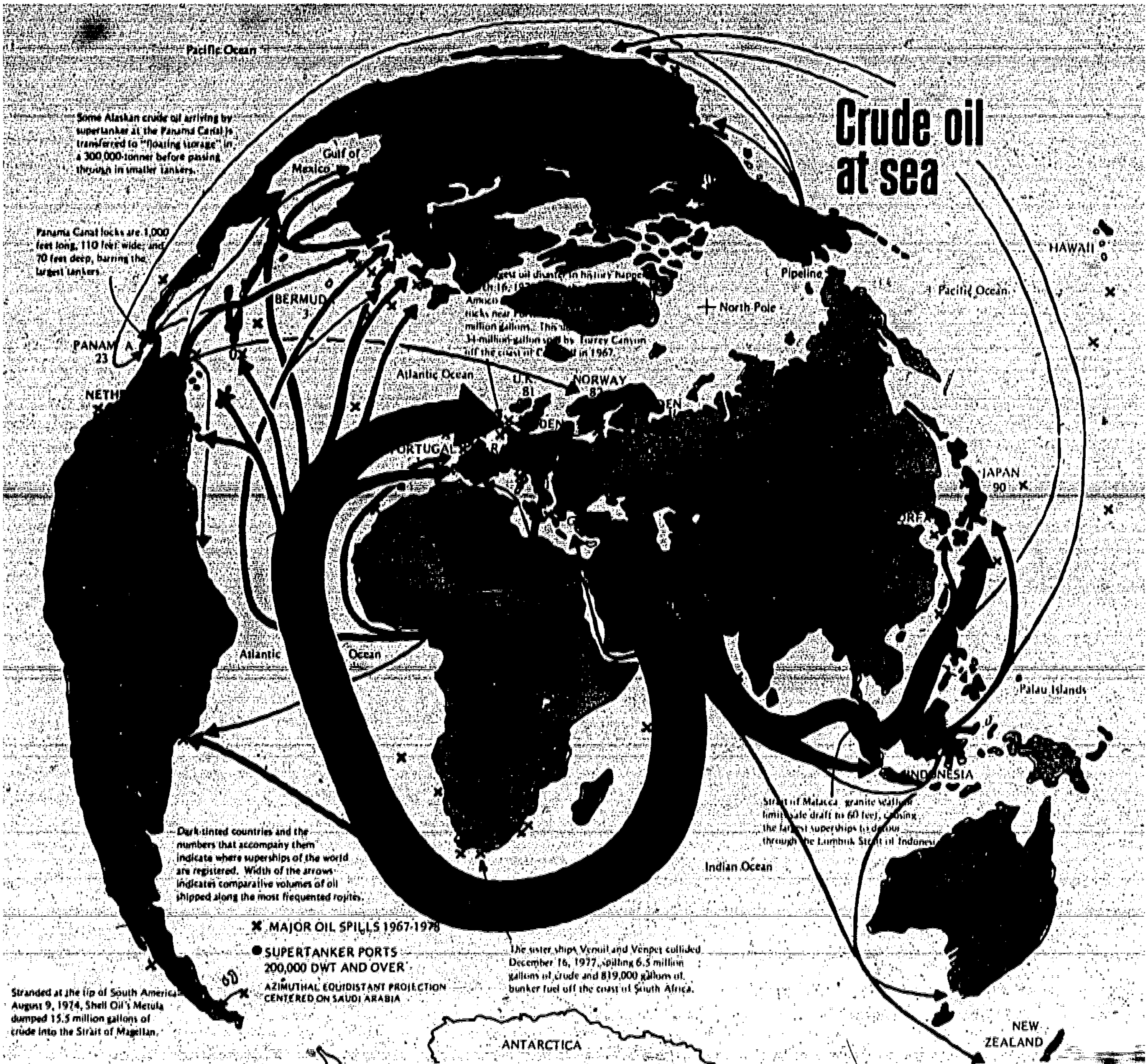
3. Have the students condisder the energy situation in terms of international trade, including the following:

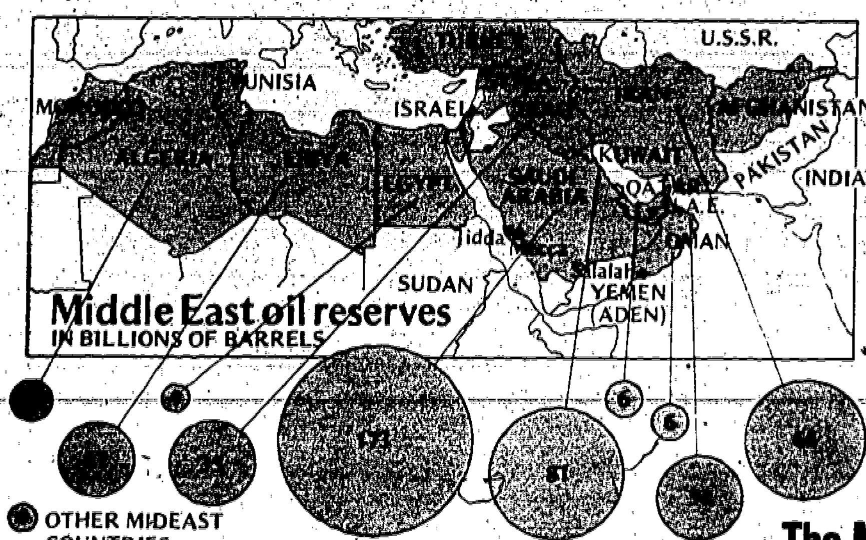
   a. The difference between revenue and protective tariffs.
   b. The possible consequences of protective tariffs upon the financial prosperity of the world.
   c. An understanding of the European Common Market. Consider the value of such an institution on a world wide basis concerning present day energy, natural resources, and food supplies.

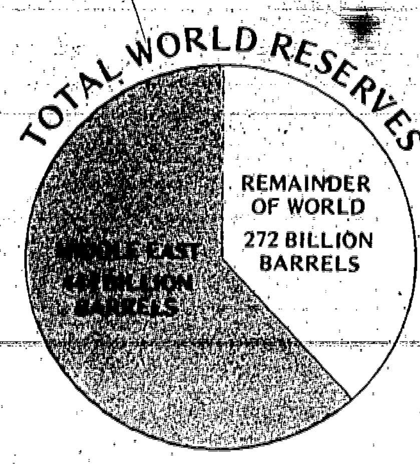
4. Students should consider the possible effects of the present energy siutation during the next half century.

   a. How will countries alter their standards of living? (This is especially important to the U.S. and Japan.)
   b. Will the countries of the world be drawn closer together or will tensions cause poorer relations?
   c. Will the less developed nations of the world assume a role of shared leadership?

Crude oil at sea

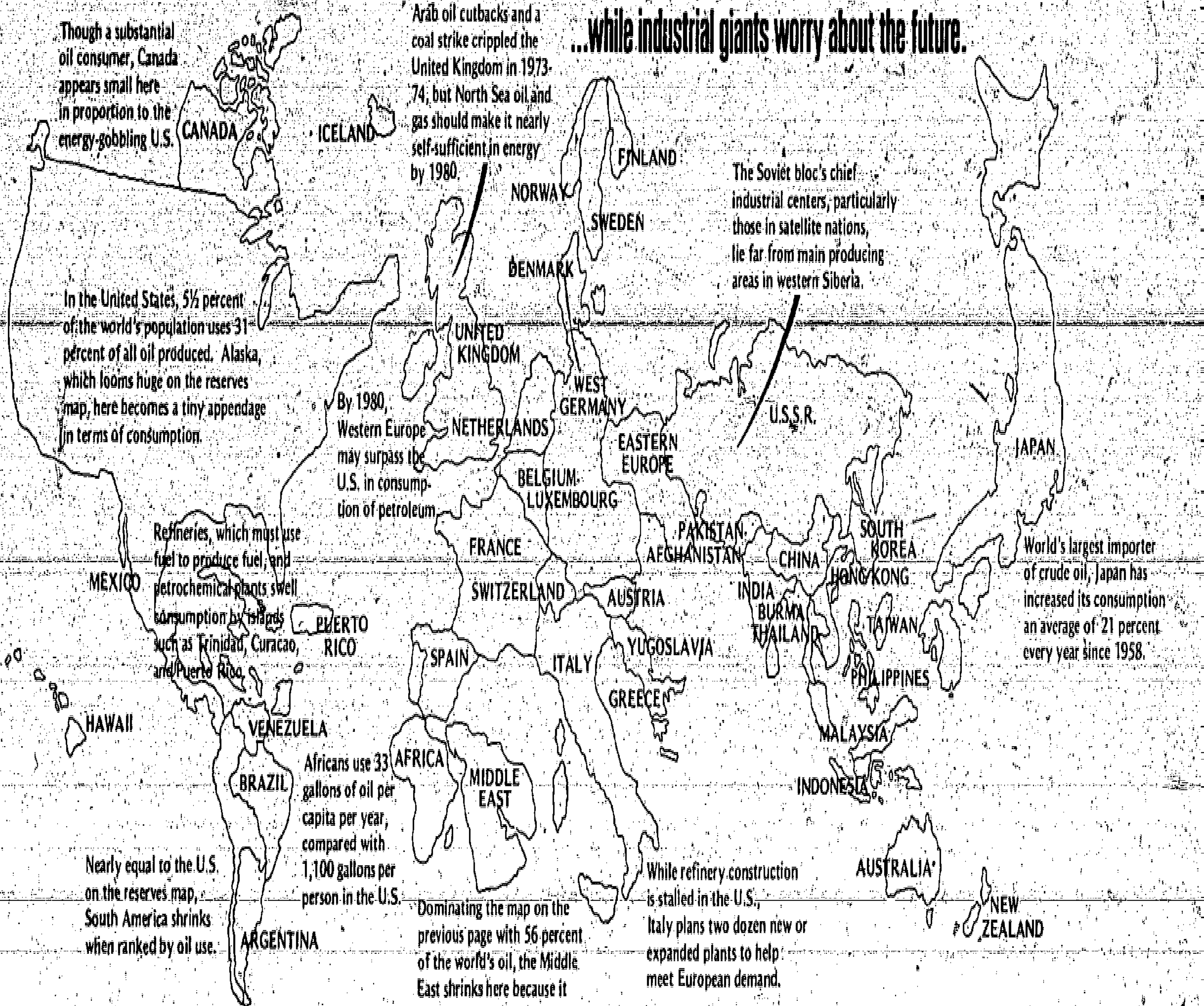




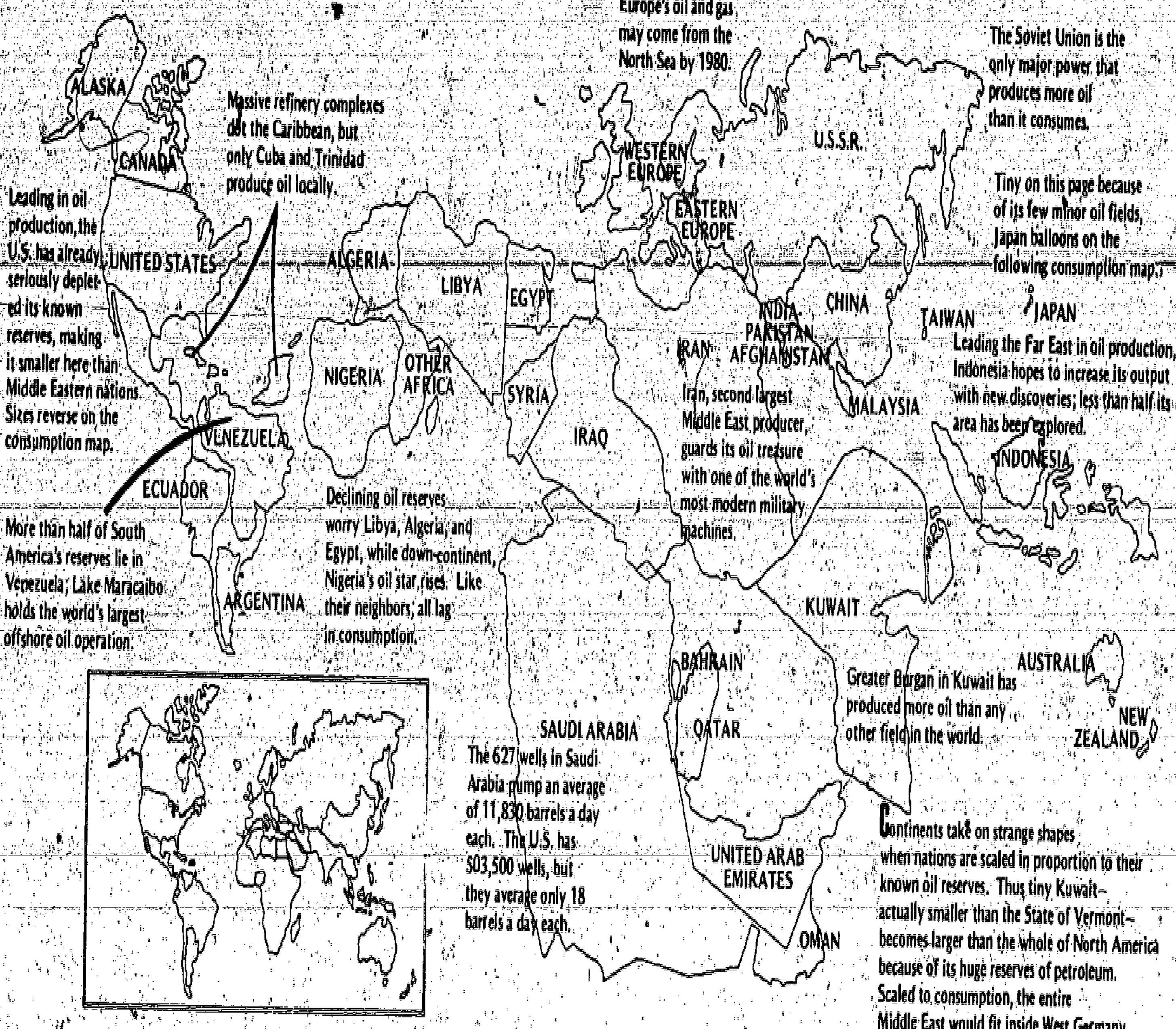


The Middle East: where the oil is

...while industrial giants worry about the future.



Oil creates new superpowers...



Continents take on strange shapes when nations are scaled in proportion to their known oil reserves. Thus tiny Kuwait—actually smaller than the State of Vermont—becomes larger than the whole of North America because of its huge reserves of petroleum. Scaled to consumption, the entire Middle East would fit inside West Germany.

UNIT IV

THE LOCAL COMMUNITY AS A MODEL

The home community is the environment where people can easily become acquainted with energy oriented issues. People go to the same stores, work in the same manufacturing plants, read the same newspapers, enjoy the same recreational areas, fish in the same streams, use the same schools, and consume energy from common sources. In many respects the home community environment is the most significant of all geographic regions. Why?

1. Studying the home community environment permits direct field observation of the physical and cultural environment. Students learn best by actually viewing phenomena studied.

2. The home community serves as the best laboratory in which to acquire the skills of identification and interpretation of environmental relationships.

3. The home community furnishes real-life environmental situations.

4. Studying the home community environment provides a data base for comparative evaluation of community environments.

5. Studying the home community environment encourages detailed interpretation of maps.

6. The home community environment is the primary place where good citizenship can and should be practiced.

7. Home community environment study contributes to better school-community relationships.

The energy issue is a topic that lends itself to the social studies disciplines particularly when the local community is analyzed. A community land use mapping exercise that takes in the entire community or simply a neighborhood could provide a focal point. Analysis and description of the sutdy of land use presents students with the following total social studies overview: (1) study of the spatial evolution of the city to help explain WHY the city was located WHERE it was, HOW the city has grown, and WHAT some consequences are of city growth and urban development; (2) study of the economic growth and development of the city; (3) study of the different social processes at work in the city; (4) study of political divisions and processes at work in the city and hinterland; (5) study of the psychological basis of behavior in city regions; (6) study of the history of the city and architectural periods; and (7) perfecting techniques of field observation and social perception.

Key issues concerning community energy usage will be generated. What land use types consume the most energy? Where are they located? If energy supplies were reduced to your community, what economic impacts would occur? What areas of your community seem to have the poorest insulation and heating systems? Is the land use pattern in your city designed to reduce the need for automobile transportation? Can students walk to school or the store? How much energy is used by houses built during certin architectural periods? What are local governments doing to conserve energy? What types of heating and cooling systems are used in your community? Will zoning and planning in your home community reduce total energy consumption?

After students become familiar with the social - energy issues of the local community, they can

present energy saving tips to members of local government, schools, home owners and parents. The following is a sample list:

At Home

Caulk windows and weather strip doors.
Install storm windows.
Insulate attic, exterior walls, floors over unheated spaces, air ducts and water pipes.
Keep fireplace dampers closed unless the fire is burning.
Replace heater filters each month.
Let sunlight in for extra heat and shut it out when cooling.
Turn off all lights when not needed.
Run full loads in the dishwasher and the laundry.
Take showers instead of tub baths.

On the Road

Eliminate unnecessary trips—walk when you can.
Drive at moderate speeds.
Have your car tuned regularly.
Keep tires properly inflated.
Buy the most energy-efficient car for your needs.
Use public transportation if possible.
Join a car pool.

At Work

Use fresh air ventilation instead of air conditioning where possible.
Consider burning your company's waste and recovering heat for use.
Cut back on exterior sign and architectural illumination.

A good student project would be to complete an energy checklist for the local school district and suggest to school officials how energy conservation can be practiced at the local schools. A list of energy saving tips could be put together by students and published in the local newspaper.

Resource Personnel to Contact

Students should be aware of the decision-makers at the local level who influence energy decisions through the private, political and governmental process. They provide a valuable resource of information to be used in classroom projects and in research studies, and many times they are willing to come into the classroom to discuss their roles with students. These individuals come from both the public and private sectors, can be elected or appointed officials, developers and builders, or members of public interest groups. Input from these key resource people can help clarify many of the local community energy issues.

The following is a list of resource people to contact.

Resource Personnel

Locally Elected Officials

County Commissioners
Township Commissioners and Supervisors
Borough and City Council Members
Mayor
School Board Members

Appointed Officials

Municipal Manager and/or Secretary
Planning Commissioner Members
Zoning Hearing Board
Members of Other Bords and Authorities such as Energy Commission and Recreation Commission
Solicitor
Municipal Engineer
School District
Superintendent
Business Manager
Personnel from Commonwealth Agencies such as the Department of Environmental Resources or the Governor's Energy Council
Environmental Education Coordinator at the Local School District
Soil and Water Conservation District Personnel
County Planners
Local Power Company Representatives
Professional Planners or Consultants
Chamber of Commerc Officers
Representatives of Civic Organizations
Key Individuals in Local Interest Groups
Private Builders and Developers
Local Plumbing and Heating Representatives

Activity IV-1

Objective

Students will interview with parents and community leaders to find out the various types of heating systems used in the home community.

What to Do

Talk with individuals in the home community having various heating systems. Compile a list of heating types and overall costs of each. What heating system would you use if you were building a house? How do you think most of the houses will be heated in your home community in 20 years? Why?

Teacher Notes

Review what energy sources are used to produce energy in your home community.

Activity IV-2

Objective

Students will divide the community into districts and map the residential, commercial, industrial, and recreational land uses.

What to Do

Students should obtain local maps from the Chamber of Commerce. Major energy users in the community should be indicated on the maps and interviewed.

Teacher Notes

A checklist should be constructed to get students thinking about energy relationships and land use. How do students get to school? Where are shopping facilities located? Where are employment sources located? What is the locational relationship of work and school to recreational facilities?

Activity IV-3

Objective

Students will perform field research defining areas in the home community where energy saving tips are most needed.

What to Do

Publish energy saving tips in school bulletin and local newspapers. List people in the home community who can be contacted to give an energy review of individual houses to reduce energy costs.

Teacher Notes

Check with school officials so that students can perform an energy check of the local school building. Energy conservation suggestions should be published in the school paper.

Activity IV-4

Objective

Students will interview energy resource personnel in the home community.

What to Do

Write short student papers explaining how local community leaders are trying to conserve energy.

Teacher Notes

Review the energy conservation plan for the school district with students.

Activity IV-5

Objective

The students will discuss the rationale, contents, and use of an environmental impact statement.

What to Do

The Biology Module has an activity on Environmental Impact Statements which includes a table of contents of an environmental impact statement for a proposed electrical transmission line. Obtain a copy of this activity and have the class discuss the rationale and possible environmental effects of the various items included.

Activity VI-6

Objective

Students will clip out newspaper articles and use periodicals to review current attitudes on energy consumption.

What to Do

Read the April 25, 1977 issue of Time and review hypothetically what life would be like in 1997 if we continue to use energy at the 1977 rate of consumption. Students must perform the following activities:

1. Describe how people in 1997 would get to work.
2. Discuss what changes would occur in housing patterns in the home community in 1997.
3. Make a chart of the advantages and disadvantages of life without abundant energy supplies.
4. Study the class land use map of the home community and discuss how land use would be different in 1997 compared to today.
5. Debate the following: It is better to increase efforts to find new energy sources than to limit present uses of energy.

Teacher Notes

Have your class make a list of conditions that might appear in energy-scare 1997 and compare them with conditions in an earlier energy-scarce period, 1877.

COMMUNITY REACTION TO THREE MILE ISLAND

Three Mile Island is a nuclear power plant which used uranium in a fission reaction to produce electricity for four million people in an area that covers 24,200 square miles. It is located ten miles south of Harrisburg on an island in mid-stream of the Susquehanna River. The Three Mile Island plant is surrounded by a diversity of land uses. The very heart of Pennsylvania's agricultrual industry, the urban center of Harrisburg with numerous commercial and industrial plants, and residentail communities that are growing in the region, all are located within the shadow of Three Mile Island's cooling towers.

What sort of impact would a 1.3 billion dollar power plant have on an area, especially when nuclear power is so controversial? What is uncertain are the safety aspects. When the unthinkable occurs, and an accident does happen, there is realistic cause for alarm. The incident at T.M.I. must be looked at carefully, because it has set a precedent in community reactions and attitudes toward nuclear power.

Intially when the plant was being built there seemd to be very little concern over nuclear power. Communities realize our dependence upon foreign oil imports, and see nuclear power as a way of easing off this dependence. T.M.I. occupies a small tract of land, and nearby communities are buffered by an abundance of open space and the flowing waters of the Susquehanna River. Typical fossil-fueled generating plants sprew out visible pollutants and obvious odors. In contrast, nuclear power plants are clean with respect to these kinds of pollutants, and as industrial structures they are rather attractively designed in external appearance and aesthetically pleasing. Considering this, it is easy to understand why communities can become complacent during the construction and operation of a plant such as T.M.I. People in the environs of T.M.I. learned to live with the plant over the years. However some residents feel it is like living with a rattlesnake, sooner or later it's going to bite but you just don't known when.

[illegible] nuclear generating facilities and much of this is supposed [illegible] reflection of fear for health and safety. If individual perceptions of possible health and safety impacts are real and strong, then these should be reflected in the individual's choice of a housing location. The Pennsylvania State University undertook a study to test the hypotheses that nuclear power plants have an adverse impact upon community growth and residential property values. Looking at four nuclear power plants in the Northeast (T.M.I. not included) the conclusion was that for most people in these study areas the proximity of a nuclear power plant did not appear as a factor in residential location choice. The fears for health and safety expressed by some individuals and groups in society are not reflected in the housing decisions of the residents in the communities near the nuclear plants studied (cf. B. Gamble, R. H. Downing, O. H. Saunders, 1977).

[illegible] plant [illegible] March 28, 1979 [illegible] to [illegible]

[illegible] real or imagined radiation emissions and [illegible] possibilities [illegible] fear.

[illegible] announcement [illegible] of the plant precipitated more [illegible] and [illegible]

The community began to react to T.M.I., and recommendations such as remaining indoors, closing windows, and the possibility of evacuation were issued. Students were sent home from school, and in some cases were moved to other locations. Many citizens did not wait for the order to evacuate, because surveys indicate that eventually 144,000 people or 39% of the population in a 15 mile radius of T.M.I., left the region for *safer* destinations. Long lines began to appear at the gas stations and there was a marked increase of traffic on the highways. In essence the community surrounding T.M.I. began to react quickly to the potential danger of a major nuclear incident

Commercial and retail businesses within five miles of the plant closed because nearly 75% of the people had left the area Banks were hit with heavy withdrawals by their customers The industries in the area also suffered high absenteeism but plants such as Bethlehem Steel, which employes 3500 people, were able to remain open. Smaller firms such as Presco International, which employes 50 people, had to shut down completely. Foodstores within a 15-20 mile radius of the plant reported selling out of prepared foods and canned goods. Hospitals began to experience a shortage of workers

The threat of evacuation raises the serious question [illegible] behind [illegible] nuclear accident Someone must supervise the evacuation keep the peace respond to emergencies and maintain vital services Farmers have to remain to care for livestock and other animals The Pennsylvania Emergency Preparedness Agency (formerly Civil Defense) has the responsibility to decide evacuation procedures

[illegible] the long term community response will be cannot be so easily assessed An accident like T.M.I has stimulated the anti-nuclear power lobbies into concerted action and demonstrations Public opposition to nuclear power has risen dramatically and many women and children from the area who were most affected by the incident have joined protest ranks for the first time Some families within 15 miles of the plant have decided to relocate after the traumatic experience The agricultural industry has suffered because people [illegible] consuming milk and other food products produced in the fields of central Pennsylvania Farmers have expressed concern about their land values, and future farming in central Pennsylvania Finally the non-scientific public has begun to lose faith in the pronouncements of the scientific community believing that some of our technological advances must be reviewed with extreme care before acceptance Many scientists have been stressing this community involvement for quite some time

Teacher Notes

- Encourage students to look at all forms of transportation: bus, rail lines, etc.

Activity IV-8

Objective

Students will determine the number of people in local communities who would need help in case of a nuclear incident. Consider the disabled, elderly, individuals who are hospitalized, and those people lacking automobiles.

What to Do

Check with local hospitals, municipal officials, and emergency safety people to determine the number of individuals involved in an evacuation. Try to determine what types of transportation would be utilized. Check to see if emergency evacuation services are available for your region.

Teacher Notes

Explain [illegible] ... determine if emergency evacuation services are available for the elderly, disabled and hospitalized.

Activity IV-9

Objective

[illegible]

What to Do

[illegible]

and magazine articles about T.M.I. Was there a difference between local and national coverage? Were any sources particularly biased or objective? Is there a way that people in the community can receive accurate, understandable information in such emergencies?

Activity IV-11

Objective

The students will construct a community attitude survey to try to assess local community attitudes about nuclear power as a future source of energy, and about locating a nuclear plant in your community.

What to Do

Have students [illegible] incorporated in the community attitude surveys. Construct a sample survey and use [illegible] in the local school and community. Use this opportunity to help your students for a techniques in construction of a questionnaire. Develop a model questionnaire for students to review and study. The model questionnaire should be used by students in developing a community attitude questionnaire.

[illegible]

[illegible]

[illegible] operation of a coal burning power station [illegible] was released [illegible] accident. Even [illegible] burning [illegible] coal have greater impact than those released by nuclear power plants.

[illegible]

elements of radium. Radium is a bone seeker, where it lodges and remains for the rest of the person's life. What health effects might this have?

Where should a coal-burning power plant be sited to reduce its health effects? Remember that the wind will carry the radioisotope-bearing smoke.

All human endeavors carry an element of risk. According to the Congressional Office of Technological Assessment, the use of coal in the U.S. was responsible for 48,000 premature deaths during 1977. Is this an acceptable risk? Compare this with annual automobile fatalities. What determines an *acceptable risk*?

Many persons do not understand [illegible] radiation. How did this contribute to the panic during the Three Mile Island accident?

U.S. Environmental Protection Agency. EPA 520/7-79-006. Radiological Impact Caused by Emissions of Radionuclides Into Air in the United States. August 1979. Pages 4-4-1 to 4-4-27.